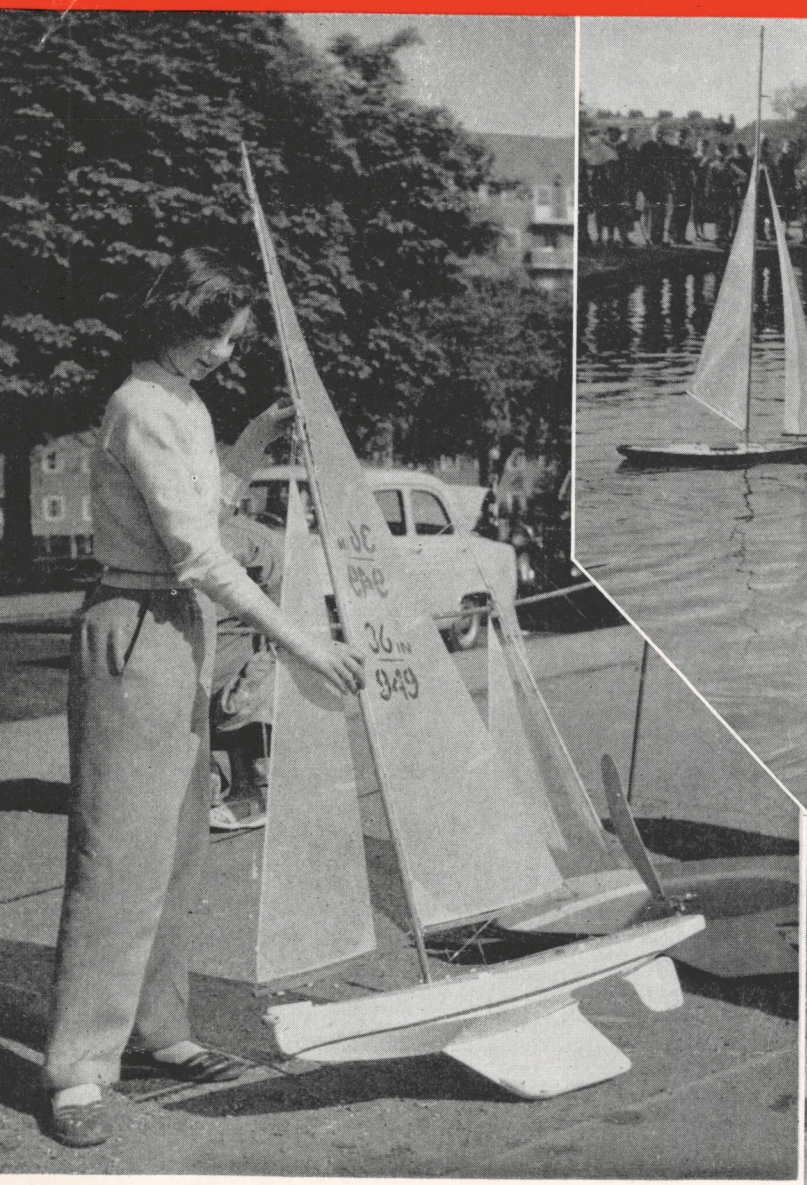
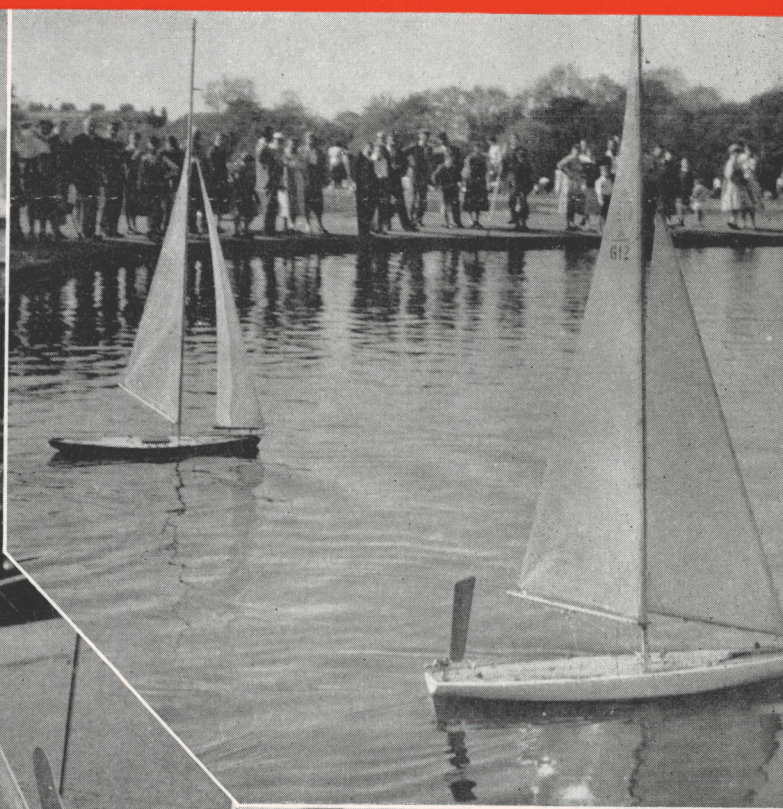
# Model Engineer

THE MAGAZINE FOR THE MECHANICALLY MINDED





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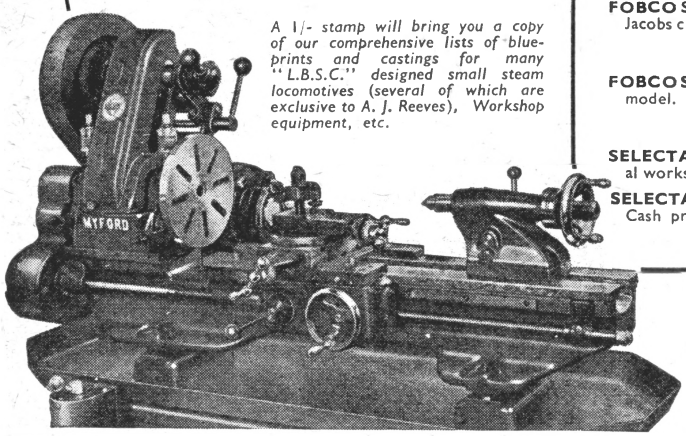


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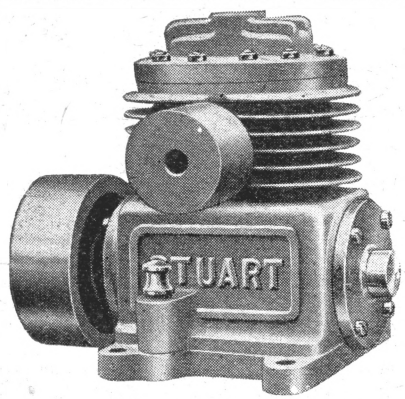


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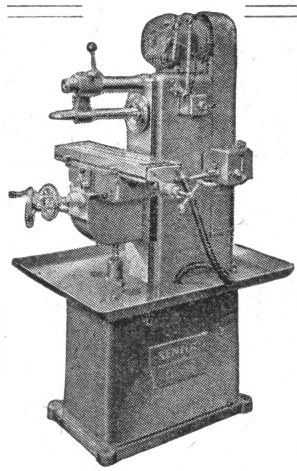

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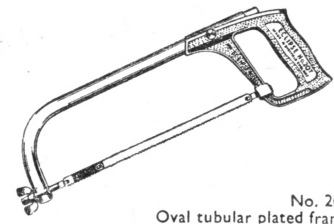

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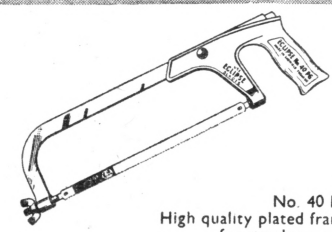

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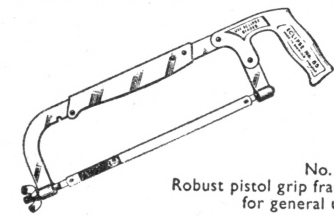

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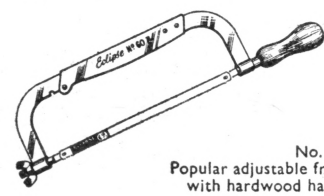

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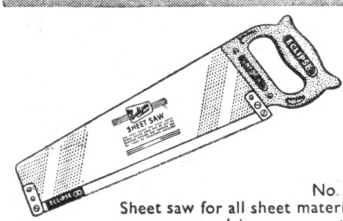

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The ME Jubilee clock

Pitch circle scriber


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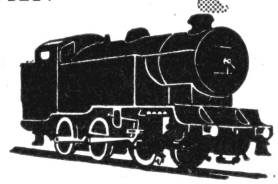
# Smoke Rings

*By VULCAN*



ALTHOUGH the opinions of readers, as expressed in recent Postbag discussions, indicate a substantial majority in favour of devoting the home workshop exclusively to model activities, there are many readers who believe in making the workshop pay for itself, or at least to bring in some little remuneration to assist maintenance, or the purchase of improved items of equipment which it is every model engineer's ambition to possess.

My advice is often asked by impecunious readers on how to utilise the workshop profitably, and in quite a few cases I have been able to help them in this matter; I certainly have nothing in common with those joyless people who seem to believe that there is something sinful in trying to turn an honest shilling.

## Helping neighbours

Model engineers can often provide a useful service to the community and do themselves a bit of good at the same time, by taking on small repair or construction jobs which all too often are deemed to be beneath the notice of professional firms in this day and age.

In all sorts of machinery nowadays, from motor-cars to alarm clocks, repairs, in the true sense of the term, are not considered worth while; the customer is recommended to have a spare part fitted if it is available—if not, "scrap it and buy our latest model, thank you!" Yet many, if not most, of these things are repairable, and capable of a new lease of life, at the hands of a real craftsman.

Another opportunity which often occurs is in the construction of appliances or machines for some special purpose, for which a standard mass-produced article does not fulfil requirements. In the past, many readers of ME, starting in this way to help their friends and neighbours by services which cannot be obtained elsewhere, have laid the foundations for solid and substantial full-time businesses.

## Avoid

Some readers who have sought to employ their workshops to profitable advantage have made the mistake of trying to emulate manufacturers by producing similar articles to those which are already available.

It is not beyond *possibility* that the amateur, with very low overheads, may be able to make certain articles more economically than the professional, but there are many risks in attempting to do so, some of which may not be apparent until they actually rear their ugly heads. Such matters as patent rights or registered designs may not only introduce a practical hazard, but may in some circumstances lead to real trouble financial and otherwise.

In our Postbag discussion, one reader suggested that amateurs might, among other things, undertake to produce such domestic appliances as lawn mowers and sewing machines. But even discarding the profit motive, and assuming that these are for personal use only, they are typical examples of appliances which can be produced far more cheaply by the professional than the amateur.

## Mass production

Many sins are ascribed to mass production, but it does enable individual labour costs to be cut to the minimum, and many articles nowadays are produced for little more than the cost of the raw materials. One outstanding case is that of the fractional h.p. electric motor we use to drive our lathes—it is marvellously cheap yet highly effective.

The amateur who sets out to construct a sewing machine or a lawn mower may find that the raw materials

may actually cost *more* than he could buy the finished article for; and while we applaud the enterprise of anyone who tackles a job of this nature for the fun of it, we think that from the aspect of workshop economics it is more likely to prove a blind alley. Much better prospects lie in making something of a more exclusive nature, or putting in just that bit of *individual* craftsmanship which the manufacturer cannot afford.

## Touring Europe

JAPAN in time for the cherry blossom, England in time for the bluebells. Mr and Mrs Milton A. Powers have travelled 50,000 miles since they left their home in Detroit. They spent Christmas in Marrakesh, and when they arrived in London for the spring they were as fresh as daisies after motoring through the Mediterranean countries and up to Brussels for the Fair.

Mr Powers is a full-scale engineer by profession and a model engineer in his spare time—of which he normally has little. Feeling that his 50,000-mile tour would not be complete without a visit to 20 Noel Street, he called to see us with his son David. One of the souvenirs which he will be taking back with him is a model—an example of the work done by model engineers in England.

David Alden Powers is a student in California and such an enthusiast for acqualung diving that he took part in attempts to salvage a fishing boat which had sunk off the Costa Brava. The aqualung clubs in Barcelona and Rome made him a member !

## Coincidence

Young Mr Powers represents the eleventh generation since a family called Power left England for America. His second Christian name commemorates a link with John Alden, the Pilgrim Father who did the courting for Miles Standish—as Longfellow relates in one of his most famous poems.

Here we come to a coincidence. Only the day before, on one of the London bookstalls which Mr Powers was intending to visit, I had picked up an old illustrated copy of *The Courtship of Miles Standish*; and when I opened it at random to show him one of the New England colour prints we found ourselves looking at a picture of John Alden !

## Complete circuit

IT is strange how the wheel of life often turns full circle. Who would have thought a generation ago that ships would be carrying coals to Newcastle ! Something of a similar nature has occurred with Percival Marshall recently.

Some of the most popular books published by this house were the Marshall's Practical Manuals which were introduced at the turn of the century.

No 2 in this series was a volume titled *Private House Electric Lighting*. Written by Frederic H. Taylor, a consulting engineer and a member of the Institution of Electrical Engineers, it was a textbook much sought after by the wiremen of those days.

One copy has since been acquired by Mr Philip Honey, an official of the British Electrical Development Association, and he tells me that it now forms part of the Association's electrical museum.

## Need for order

Since those early days tremendous progress and development have taken place in electrical installations, and vast industries and corporate bodies have replaced the humble generating station and the home-built power plant. With this expansion has come a multitude of fittings, appliances and wiring systems. At one period chaos threatened.

So the British Electrical Development Association was created with the specific object of laying down certain desirable standards and uniformity so that manufacturers, contractors and consumers could agree on definitions, terms and practices.

But it takes a long time to achieve uniformity of purpose and design and the process is still largely transitional. What is accepted today may be outmoded tomorrow.

So the wheel has turned full circle. When one of my colleagues has a query concerning electrical installation, what does he do ? Right first time ! He rings Mr Philip Honey—who acquired some of his knowledge from an early Percival Marshall book !

## Talyllyn

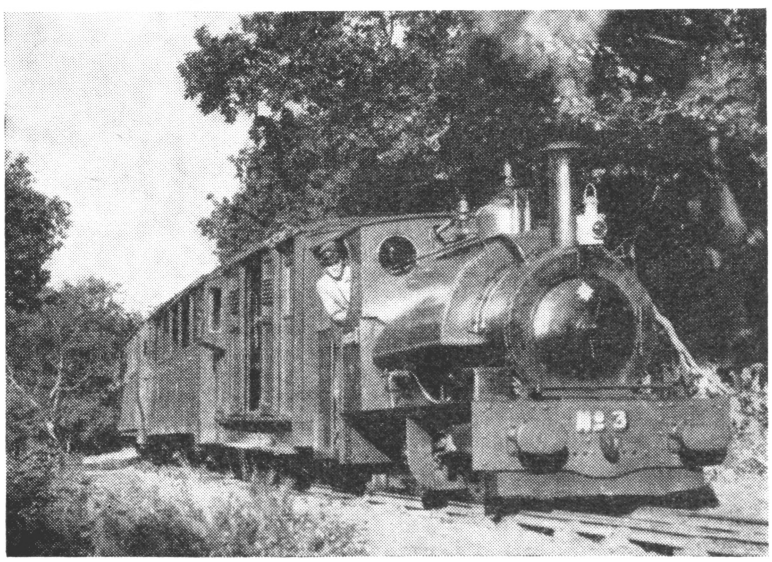
THE narrow-gauge Talyllyn Railway gets up steam again this month with two trains each way weekdays between the terminals of Towyn and Abergynolwyn. After July 23 and until August 30 an extra train will be introduced to cater for summer visitors.

The organisers conduct an annual photographic competition with a prize of two guineas in each section—black and white, and colour transparencies. Details and entry forms may be had from Mr R. K. Cope, of Brynglas, Beckman Road, Pedmore, Stourbridge, Worcs.

For the enthusiast there are working drawings available, an official guide (1s.), photographs of the rolling stock (4d. each) and a timetable (1d.).

### Cover picture

*The Clapham regatta. Edward Bowness writes of the first model yachting regatta of the season on page 704.*



*Locomotive No* 3, SIR HAYDN, *of the Talyllyn Railway, at Abergynolwyn*

# Some problems of design

**A. A. SHERWOOD concludes his first two-part series on the difficulties of fine-scale modelling. Others in this series will appear from time to time**

*Continued from 15 May 1958, pages 629 to 631*

LOCOMOTIVE cylinder blocks in ultra miniature gauge raise fascinating problems.

This example was worked out many years ago for use in a OO gauge steam locomotive: it was so successful that the same design was used recently in a OOO gauger. The details of this locomotive appeared in ME 31 October 1957, but the basis of the design is more relevant here. Briefly, the requirement was to design a cylinder block for a OO gauge live-steamer with outside cylinders and inside valve gear; to give a reasonably close resemblance to full-size practice externally, but performance not to be sacrificed. Ease of assembly was desirable and also a minimum number of parts.

(At that time the author fondly toyed with the idea that it might become a commercial possibility, as it was obvious that a OO gauge live steamer could be made to sell much cheaper than the colossal price charged for a dummy steam exterior with an electric motor in it and miscalled a super-detail model. After a look-see into the state of affairs in the professional model maker's world, however, I found that the real achievements in this field are still in the hands of the amateurs, and decided that I'd better remain in their ranks.)

The design eventually reached, therefore, was dictated by other than technical criteria, but the result would not be improved by disregarding these.

**Reducing components**

The considerable reduction in the number of parts compared with the conventional design was obtained by: rear cylinder covers permanently fixed to block-front covers screwed in—no studs and nuts involved; slide-valves of special design held to the portface by springs—no valve chests, glands, etc., required; all passages to be formed in the body of the block—no external pipework.

None of the above points adversely affects the operation of the locomotive. The main criticism that can be raised against the appearance of the finished cylinders is that they are over scale length, this is essential for good operation, as scale length pistons would not stay steamtight for long, and the same defect would be apparent in the conventional design.

The rear covers were soft soldered as a seal after press-fitting the spigots, and the front covers are held by two turns of 40 t.p.i. thread. No claim for originality is made for the slide valves as I can recall seeing some German toy steam engines with valves of this type about 30 years ago, but to my knowledge, they have not been applied to model locomotives before. The problem of forming the passages in the block was greatly eased by using channels cut in the surface with a cover plate over them. On this size locomotive, pinhole ports are quite adequate, and the apparently excessive length of the ports to the ends of the cylinder is of no consequence, although I shudder to think of the consequences if I were to propose this design for a 5 in. gauge !

Fig. 5 shows the essential features of this design. It is worth mentioning here that these slide valves will also act as safety valves, and do so better than any specifically designed for that purpose on a small boiler, as they will both open and close at nearly the same pressure; the normal safety valve dribbles and needs a wallop on the head to make it shut tight, and the pop type wastes water that can be ill afforded from a tiny boiler.

## HEAT FLOW PROBLEMS

In the design of heat engines, two problems frequently occur: how to get rid of heat at one place, and how to preserve it at another. In the small locomotive, one very real difficulty is to get rid of the heat that finds its way into the fuel tank, resulting in loss of fuel by evaporation, and consequent shorter run per filling. The locomotive gets hot all over, as the only external contacts are line or point contacts with the rail, and conduct little heat away. The solution to the problem is, then, to cool the fuel tank (by water cooling, as in the OOO gauge tank locomotive) or to hold the fuel in the tender.

The latter solution has been successfully applied, but it involved the additional complication of a float chamber to prevent the flooding of the wicks, and also the articulation between engine and tender must be considered. The making of very small floats is no easy task; they must be capable of floating in methylated spirit (less dense than water) with enough reserve of buoyancy to close a small stop valve. The other solution, that of water cooling, exceeded all expectations in its performance. I had intended to try other more volatile liquids for cooling but water is satisfactory in every way.

The fuel tank is surmounted by an open topped water tank, which is conveniently out of sight in the cab. The only attachment of the lamp to the locomotive is at the top of the water tank; elsewhere it is surrounded by an air space. Any heat reaching the fuel tank by conduction must, therefore, pass down the sides of the water tank first, so most of it will be extracted by the water. Unlike the motor-car cooling system, this system utilises evaporation of the coolant, hence the open top of the water tank.

On very small steamboats, the fuel tank can be kept cool by contact with the bottom of a metal hull. The problem is to prevent heat loss from the cylinder. This end can be achieved by the following measures : An adequate superheater in the boiler casing that gets very hot while the contents of the boiler are coming to the boil—this will help to mitigate the initial priming of a very small boiler; the amount of metal in the cylinder and steam chest of the engine should be kept to the minimum, or it will take a good part of the boiler contents to warm it up for starting; the connections of the engine to the hull should not be too solid as much heat will be lost here, also the engine should not be set so low in the hull that its own condensate will flood any part of it.

(Of course, there should be no leakage of condensate into the hull, but when starting up it is bound to be squeezed out somewhere and not all of it will go out through the exhaust pipe.)

Strangely enough, lagging does not seem worth while in the midget sizes, as it cannot be put on thick enough to make much difference. A steampipe lagged with, say, asbestos cord is worse if it gets wet than an unlagged pipe, and on very tiny steam plants in boats any part is likely to get wet.

There are some cases where the midget comes off better because of its size. The cooling of very large diesel engines is a complex problem due to the high volume/area ratio. In general the smaller the engine, the easier it is

to keep cool. A ½ c.c. engine really only has cooling fins on it to make it look like big brother (or sister). But by the time the really small sizes are approached, the problem is reversed, and the trouble is to keep them hot enough to fire at reasonable compression ratios.

It has been found desirable to form the wearing surfaces of hardened steel in the smallest models if lasting performance is desired. This, of course, means finishing by grinding and/or lapping.

Now a job can be set up for grinding with reference to any previously machined surfaces; but when one is restricted to lapping either due to the cost of grinding machines or the size of the hole to be surfaced, it is almost impossible to influence the final position of that lapped surface. A hole can be corrected for distortion in hardening by lapping (in fact this process is capable of better results in conscientious hands than any other process) but it is almost impossible to predetermine where its centre line will finish up or to put it where it is wanted.

By composite construction, i.e. fabrication from different metals, it is possible to ensure that only the essential portions are hardened, the rest, remaining soft, may be machined after the lapping operations. A similar purpose is served in normal full-size practice by carburising and stopping-off parts to be left soft, or machining off the carburised surface where not required before hardening. For many reasons, this is not so simple for very small parts, and a part built up of mild steel and carbon steel joined by silver solder serves the purpose better. It is necessary to have some mechanical connection (i.e. binding wire) during the heating and quenching, for obvious reasons. One example where this form of construction has been found useful is in small i.c. engine cylinders.

One of my early designs, in the days when 0.3 c.c. was really small, and long stroke was the fashion, was a ¼ in. bore × ⅜ in. stroke engine. The cylinder consisted of a tube of high carbon steel with a port belt of mild steel. The cylinder tube was machined and ports cut, and pressed into the mild steel port belt, in which the corresponding ports had also been cut. The ports were plugged with asbestos string to prevent them being filled with silver solder, and the whole assembly silver soldered and quenched out in water. It was then stress relieved (very important) but not tempered.

The lapping of the bore then proceeded until a straight parallel hole was obtained. This bore was then used as a datum surface for the subsequent machining of the port belt. (This paragraph is, perhaps, out of order in a section headed design, but it seemed necessary to include details of construction to show the purpose of the composite design.) One item of importance is, however, the close fit of the joints to be silver soldered; don't try to fill up gaps with it, or you will find it blown out during quenching. It sounds rather drastic when one considers that the silver solder is liquid at the instant of quenching, but it works in the small sizes. Probably the stresses caused by the change of volume due to the rapid drop in temperature and the change of state of the solder would be disastrous in larger components, but the author has used this method successfully on components of mild and high speed steel also, quenching in paraffin oil: it should be added that the example quoted is the largest in his experience.

**Crankshafts for i.c. engines**

There is much food for thought in this subject at all sizes. In the midget sizes the crankshaft is almost sure to be overhung.

In a two-stroke, no advantage is gained from a full crankshaft, and four strokes are quite unknown in this field. The main bearings can be plain or ball-race, but the big end is probably better plain, as the size and weight of a ball-race or roller-race big end would detract from the pumping efficiency and balance. Due to the high compression ratio, forces on the bearings are large, so the crankpin should be hardened, and also the main bearings if plain.

I have had many small crankshafts hardened by chromium deposit; in this case, it is essential that the part be made of a hard steel, i.e. one that is machineable with difficulty, or the thickness of deposit needed will produce a very uneven surface, and entail long periods of lapping. To use a steel that hardens right through is obviously asking for trouble, so if casehardening is decided on, a low carbon steel with about 3 per cent nickel is suitable, and close control of the depth of case is desirable. Hardening by chromium deposit has the great advantage that no distortion is caused, although it cannot be guaranteed that the deposit will be of even thickness everywhere. If casehardening is applied, the distortion is less with a short thick shaft.

Both methods of hardening involve the difficulty of grinding or lapping up to a shoulder (i.e. the crank disc) which should not be relieved by an undercut unless the design is on the generous side. The use of ball-races obviates the need to harden the shaft, and has been found quite satisfactory;

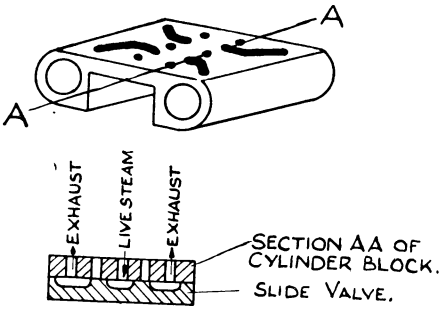



FIG. 5

but in this case it must be remembered that, unlike bush bearings, ball-races are not airtight.

**Accurate balancing**

It is possible to use composite construction, in which the crankpin only is made of hardenable steel, or to harden the pin only by chromium deposition. In order to obtain pumping efficiency, the crank disc should be left as a full circle but balance may be improved without detriment to this by drilling holes and plugging with aluminium on the crankpin side and lead (or heavier metal if you can get it) on the opposite side. It is unlikely that there will be enough room to get in as much balance weight as is desirable, so there is little point in trying to calculate the weights and their positions. This state of affairs could not be tolerated in large engines; in general, the larger the engine and the higher its r.p.m. the more important is the accurate balancing, since the out of balance forces increase as the square of the speed and the fourth power of the linear scale.

In general, it seems that very small bearings require to be made of harder material than large ones. This may be due to the fact that it is more difficult to obtain a very smooth surface on a soft metal than a hard one by lapping methods, which are the only ones likely to be available to the amateur, or it may be that abrasive particles become embedded in all but the very hard metals and lead to rapid wear. Whatever the reason hardened steel for both shaft and bearing is the most satisfactory combination to withstand heavy load and high speed without soon getting sloppy provided that reasonable lubrication is supplied.

For small locomotive main bearings, hardened axles and bronze axleboxes are quite satisfactory as even on a OO gauge the axles are not really tiny, and the rotational speed is low. The use of bronze bearings avoids the tedious operation of internal lapping, which is essential if hardened steel

bearings are used. For all cases where a sloppy fit is detrimental (i.e. valve gear joints) hardened steel on itself seems the best solution again.

Many years ago I had considerable trouble with wear on the main bearings and crankpin of a 0.2 in. bore flash steam engine. Even with hardened steel components, wear was rapid, mainly due to the lack of lubrication. Since it seemed difficult to install any adequate system of lubrication in the already complex engine, it was decided to try ball and roller-races; not, be it noted, to reduce friction but to prevent wear.

A sleeve bearing needs far more

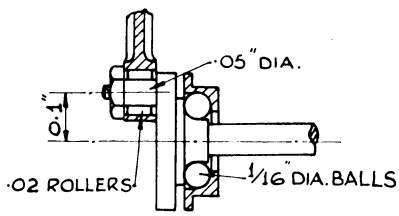



FIG. 6

lubricant than a ball-race: as a first approximation, the ball-race needs none, as there is no sliding of the surfaces in contact. More complete analysis, taking into account the elastic deformation of the balls and track, show that there is still some sliding, so a little lubricant is of service.

The engine was fitted with a roller-race big-end, and a ball-race main bearing (see Fig. 6) the sizes of which can be seen from the drawing. Although the quality of the ball and roller tracks would not stand comparison with the present day commercially produced micro-bearings, yet in service they gave no trouble whatever. One hears nowadays of wonderful claims for plastic bearings, which have applications where lubrication is difficult (such as propeller shafts) but large clearances seem to be needed with these materials, and, of course, very few plastics will stand much heat.

Where corrosion is a problem, chromium deposit is the best solution to the problem of how to get a hardened shaft. This is also worth consideration if it is desired to re-reclaim a worn or over-machined component; the result is often better than new. I have reclaimed many tiny i.c. engine pistons in this way, and found that the corrosion due to the fuel, which badly stains steel pistons, does not affect the chromium.

**Pipe joints**

The usual cone unions, banjo connections, etc., can be reproduced in miniature, but it is difficult to prevent the result looking clumsy compared with the pipe size. It is desirable to use very fine threads—in fact it is well worth while making up your own taps and dies for the job, as it is difficult to get satisfactory commercial ones. The suggested proportions are about 7 to 10 threads per diameter: for $\frac{1}{8}$ in. thread 60 t.p.i. is about right, and this is big enough for a cone union for a 3/32 in. dia. pipe if the cone is made as in Fig. 7. Of course, it is almost impossible to silver solder the cone to the pipe without spoiling the seating.

The easiest way to do it is to silver solder an oversize ring to the end of the pipe, and machine the cone on to it afterwards. If only one end of the pipe needs a cone union, this is simple, if both ends are to be so treated, a special split collet can be made to hold the ends for machining. The finished result is well worth while, as one of the features that often stand out badly even in large scale models is the even larger scale of the pipe fittings.

The main requirement in the design of the banjo union is to make the central bolt strong enough to withstand the stresses due to tightening. The cross passage in the bolt is a source of weakness; the central axial hole hardly affects the torsional strength at all. Where the design must be kept to the minimum size, the central bolt should be made of a better material than brass. Steel is to be preferred, stainless if necessary. Do not further weaken the bolt with a circumferential groove; cut the groove in the banjo itself. It is more trouble to make this way, but well worth it for the later operation of the model.

**It has to work**

It is not very elating to find (probably while trying to impress the audience

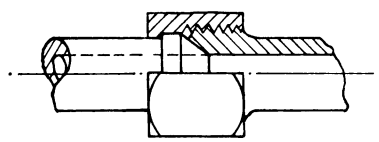


FIG. 7

with the qualities of performance) a leaking banjo union, and still less so to find the bolt twists in two when trying to stop the leak. Only one thing will convince an audience—even an audience of model engineers, who should know better—that anything smaller than the normal size working model can be anything better than a toy. That is actually to see it working. Also it has got to be started without delay for the general public; model engineers having had plenty of experience of the law of cussedness, are a bit more tolerant but still demand to see it going eventually.

In the preceding paragraphs, it has not been possible to keep strictly to the subject of design because of the interdependence of the three sections of this series of articles. It may be possible to produce a perfect design: the simplest case that occurs could be a structure that will support a given load system using the least possible weight of steel. In the simplest cases, at least, this may possibly be solved with mathematical precision.

Such a design may, however, involve very awkward machining problems, non standard rolled sections, etc., and be very costly to erect and maintain. It is, therefore, obvious that the so-called perfect design is not even good by practical standards, as it fails badly in respect of practical economy, which is infinitely more difficult to express mathematically in a form that can be applied to design in the same way as the formulas of mechanics.

**Workshop economics**

Practical economy as it affects the model engineer is also based on working time, convenience of operation and maintenance, and the cost of materials, tools, etc. The last apart, the relative importance of these factors is the concern of the model engineer himself, there is no one "right" answer, nor can any one answer be the right one. The best design, therefore, does not exist in the absolute sense.

The whole procedure of design might be summed up by the process: Decide in general terms what you want, work out a design that will operate reasonably well on these lines, investigate the problems of manufacture, assembly, maintenance and operation.

For example, it is desired to make a locomotive look like the prototype, but the room available for fuel limits the run to, say, five minutes. The boiler is adequate for ten minutes. The functionalist would say double the length of the coal bunker, and forget the appearance—so would the full-size engineer, who is in the fortunate position of having the major say in what the appearance should be anyway. The true scale fan would rather refuel every five minutes. The majority would choose some intermediate course justified by their sense of proportion, and the genius would solve the problem by the discovery of a new fuel or method of firing that would fit the scale space.

The examples just quoted oversimplifies the issue, as it is usually found that more than one component is demanding more space. ▣

# Paddle steamer BOILERS

*By W. Melville*

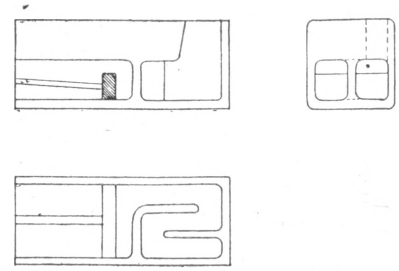


FIG. 1

MANY readers will be interested in building a boiler for Edgar T. Westbury's workmanlike diagonal engines. Before we consider the model some remarks on full-size boilers may be of value.

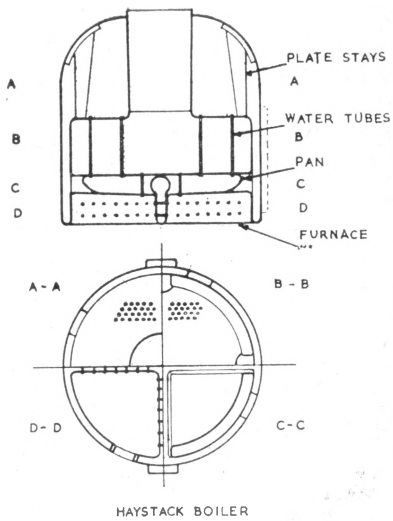
Paddle propulsion, of course, forms the whole early history of marine engineering, but as that is too wide a field I shall limit myself to the boilers used in coastal passenger craft, which Mr Westbury obviously had in mind when he designed his engines.

In the very early days the flue boiler was universal, with side-lever jet condensing engines. As the pressures were around 5 p.s.i., the engineers of these days were not restricted to the circular shell, and designed their boilers in the most convenient shape to suit the space available. A flue boiler is shown in Fig. 1, but their shapes and internal arrangements were legion. They were still built as late as the 1880s for harbour craft. The feed water was salt and muddy and a surface condenser was considered an unnecessary luxury.

Increase in steam pressures brought a few locomotive boilers into service in light fast vessels, and tubular boilers of various types became common by the 1840s. The most popular variety resembled the modern Scotch return-tube boiler, except that they were square or rectangular in cross-section, with furnaces of similar shape, and were often dry-bottomed.

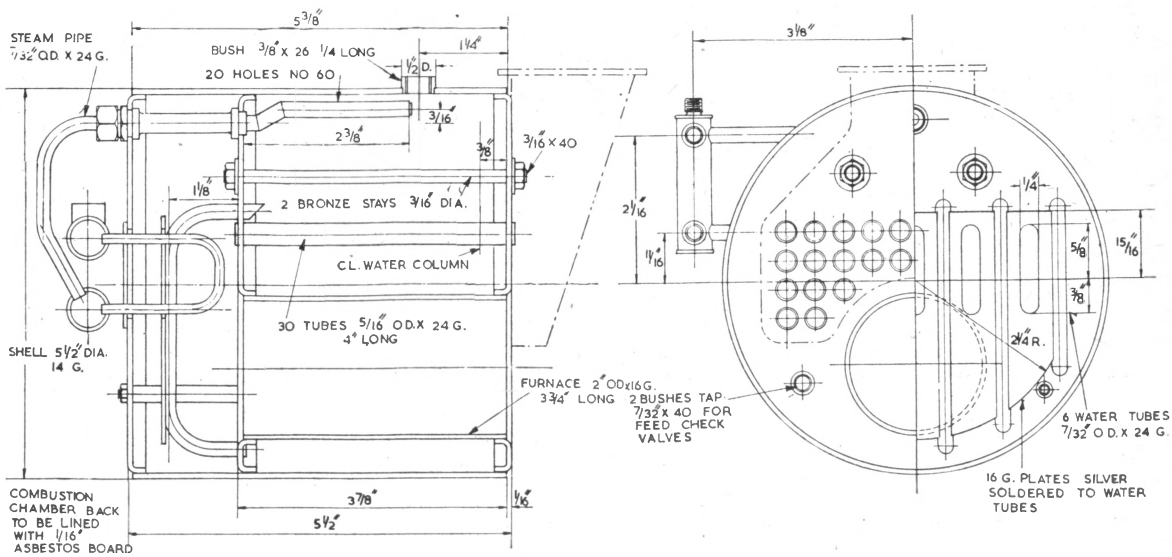
The haystack boiler, said to have been invented by David Napier, came into existence about this time and enjoyed a great vogue on the Clyde where it was usually associated with steeple, oscillating and single diagonal engines. The haystack boiler was built as late as the present century for pressures exceeding 100 p.s.i. in at least one case, though 50 p.s.i. was usual.

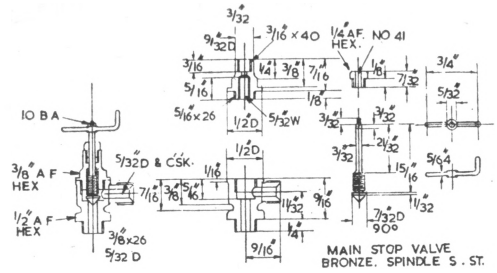
Its construction is shown in Fig. 2, which reveals that it was essentially a water-tube boiler, an arrangement made possible by the pure feed water obtained from the surface condenser. Its making must have been a feat even in these early days when the boiler-makers were evidently undeterred by the most intricate plate work. They were built of considerable size, a fast steamer carrying two boilers, perhaps




HAYSTACK BOILER

FIG. 2





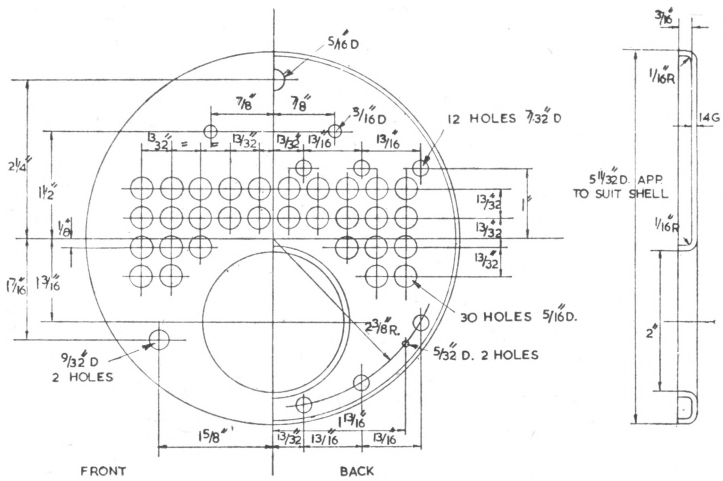

12 ft 6 in. dia. and 14 ft 6 in. high, one forward and one aft of the engine room.

The haystack boiler was well adapted to its work. The large grate area, effective tube heating surface and free draught made it very powerful for the space it occupied. The two boilers in McBrayne's famous *Columba* made steam at 50 p.s.i. for a pair of oscillating engines indicating about 2,000 h.p., which drove her finely-modelled hull at nearly 20 knots. The latest haystack I have seen, and possibly the last ever built, was fitted in the small North British Railway steamer *Lucy Ashton*, and survived until the 1940s. It worked at over 100 p.s.i., and so far as I know was unique in driving compound diagonal engines.

Compound engines and higher pressures brought the need for more robust boilers, and Scotch and navy boilers appeared in the Clyde fleet in the 1880's, with one short-lived example of a watertube boiler, installed in the Caledonian Steam Packet Company's *Caledonia*. The Scotch and navy boilers have persisted to the present day, and will never be superseded as the Clyde steamer has nearly run her course.

One feature which came in with the horizontal boiler was forced draught, which the limited grate area and high gas resistance of this type made necessary if it were to hold its own with the haystack; it had to do this, as speed paid a premium on the Clyde until the decline began in 1914. The closed stokehold system was universal. Some of the Scotch boilers were of enormous size. The *Juno*, owned by the Glasgow and South Western Railways, had a double-ended boiler nearly 20 ft in diameter, with eight furnaces, and others were nearly as large.

As nearly all diagonal engines got their steam from Scotch or navy boilers, it seems that one or other of these types should be chosen for Mr Westbury's engines. The Scotch boiler is the shorter and more compact, and is easily modified to make an efficient small generator. I have, therefore, selected it for the model. The engines have been designed as a small working set of diagonals, preserving the character of the original without being an exact model. I have tried to follow a similar course with the boiler.

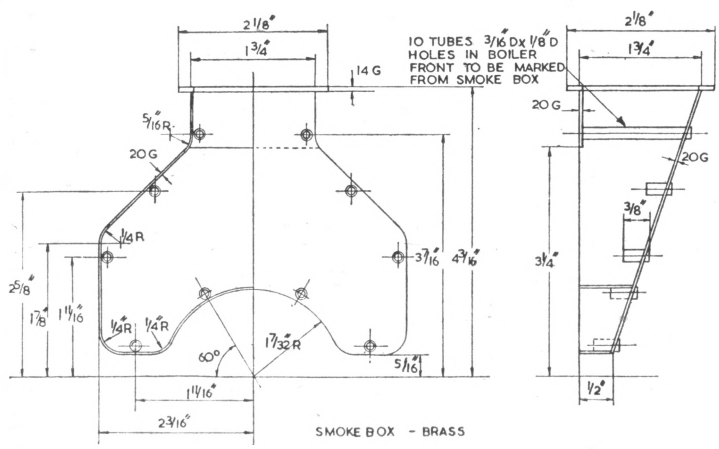



## THE MODEL

The full-size boilers were, of course, orthodox in type, generally double-ended. The model has one furnace, and the wet-back combustion chamber has been replaced by a system of watertubes which is just as efficient when fired with liquid fuel and is based on the full-size Howden-Johnson improved Scotch boiler.

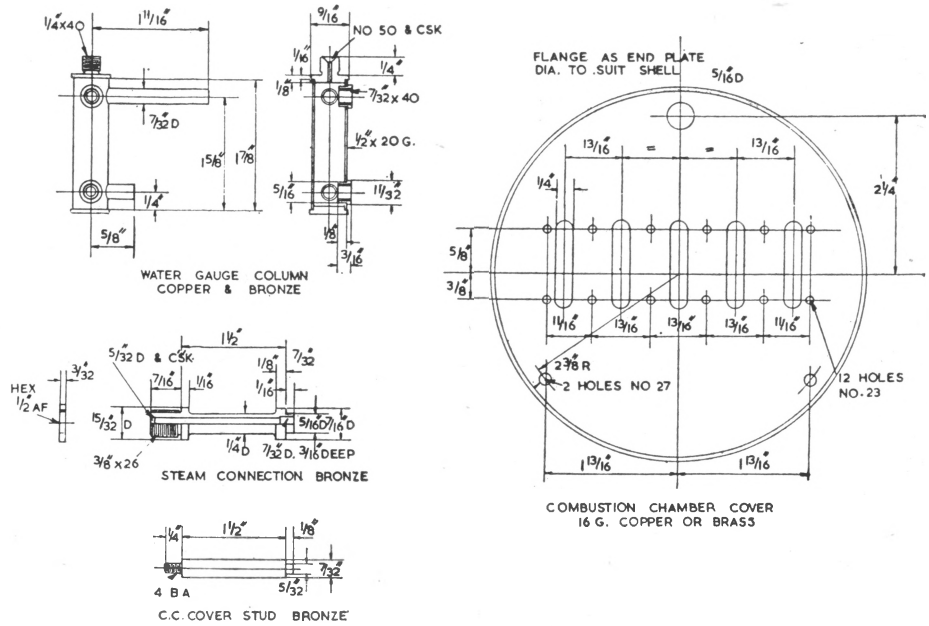
It is designed to carry 60 p.s.i., and to provide ample superheated steam to drive the engines at 400 r.p.m. which should drive a 6 ft model at a scale speed of over 20 knots. It may appear small by normal model standards, but with a good workmanship in the engines and a suitable burner it will make steam to spare.

In the absence of a special burner, this type of boiler is best fired by a blowlamp giving a short, fat, flame. A suitable burner, for paraffin, is produced by the makers of the " Monitor " blowlamp, and resembles a Primus roarer with a short barrel-shaped flame tube. A blower will be found necessary, as a compact and efficient model boiler lacks natural draught, but the merest wisp of steam through a No 70 jet will be ample when standing, and the engine ex-



# Paddle steamer boilers

*continued*


WATER GAUGE COLUMN COPPER & BRONZE
NO 50 & CSK
STEAM CONNECTION BRONZE
4 B A
C.C. COVER STUD BRONZE
FLANGE AS END PLATE DIA. TO SUIT SHELL
12 HOLES NO. 23
2 HOLES NO 27
COMBUSTION CHAMBER COVER 16 G. COPPER OR BRASS

haust will serve when under way.

Many model marine boilers would be improved by some attention to the draught, as the appalling roar made by a blowlamp does not necessarily indicate that the flame is receiving enough oxygen to burn efficiently.

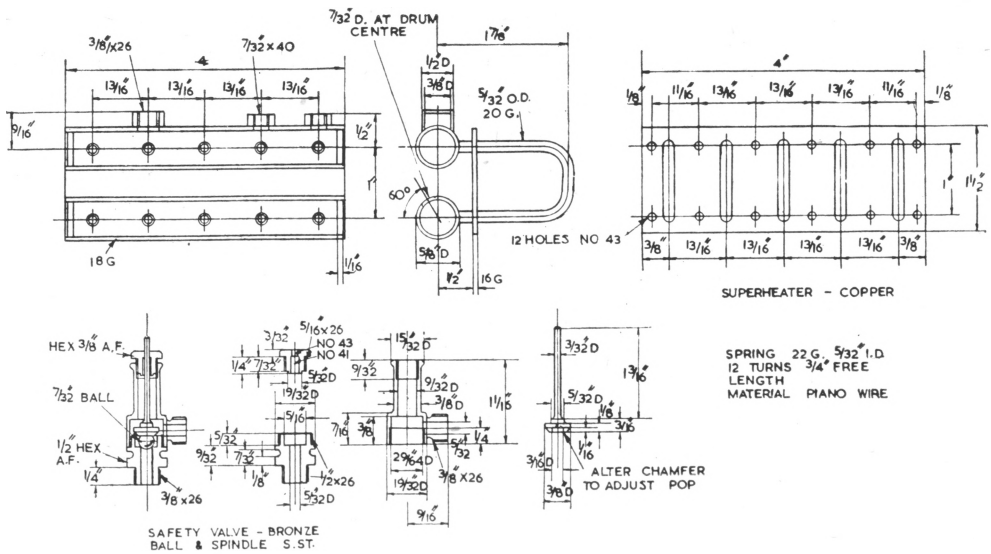
The superheater area may have to be altered on trial; I cannot pretend that the surface is right, but it seems reasonable. The design allows any auxiliaries, such as the blower and possibly a steam pump, to be supplied with superheated steam, to the benefit of their thermal efficiency. But if a bilge ejector is fitted it will need saturated steam.

I have not shown any mountings except the main stop and safety valves, to which I have tried to give a marine flavour. LBSC has described so many thoroughly practical examples that the constructor should have no difficulty in providing his boiler with the full complement.

Construction is quite straightforward, all the joints being silver soldered. It is essential that the combustion chamber baffle plate be thoroughly soldered to the water-tubes, as it does not only deflect the flame but acts as extended heating surface. The securing of this plate should be the last soldering operation, for the joints where the tubes enter the backplate are obscured when it is fitted.

No method of fixing the boiler in the hull is shown, but it should sit on a pair of cradles and be secured by ties to the frames of the vessel. The ties are inconvenient in a model, and a better arrangement would be to strap the boiler to the cradles with brass bands.

I hope many model engineers are turning to the paddle steamer. The beautiful ships of the classical days have gone, but perhaps they will have little sisters to keep their memories green. ▣


12 HOLES NO 43
SUPERHEATER - COPPER
SPRING 22 G. 5/32" I.D. 12 TURNS 3/4" FREE LENGTH MATERIAL PIANO WIRE
ALTER CHAMFER TO ADJUST POP
SAFETY VALVE - BRONZE BALL & SPINDLE S.ST.

By GEOMETER

# Repair gear cutting

IN cases of temporary repairs to gears, repairs by pegging, or otherwise where only moderate accuracy is required—and speed may be a factor—filing tooth profiles are acceptable methods, using simple contour and spacing gauges. Often, too, pegged teeth can be improved by filling in the curved spaces with soft solder or brazing material, to provide a longer effective contact line. This can reduce noise and shock, with the main strength of the substituted teeth residing in the screwed-in pegs.

A higher standard of accuracy in finishing, both in contour and spacing, naturally follows where machining is practicable—either planing, endmilling, or forming with a slotting-type gear cutter, in conjunction with suitable indexing. Nor need this last, even in the absence of dividing means, occasion a problem, for a gear with most of its teeth existing can be used with a simple fixture, and the work performed on a lathe, milling machine, or shaper.

**Mounting in the chuck**

For a mounting in the lathe chuck, when teeth may be finished by planing with a tool on the slide rest, or when a milling attachment can be mounted on the slide rest, the set-up can comprise a mandrel for the gear, and an arm of flat material for locating and indexing by means of a bolted-on jaw, as at *A*. The gear should be a push fit on the mandrel turned down to take it, and the bar can be drilled or bored to the same diameter—when a nut at the end will hold all together. Fixing of the arm to prevent movement can be from the lathe bed or stand, or the bench behind it, by bolting to a bracket; and an enlarged or slotted hole will permit slight adjustment for a tooth space to be set at lathe spindle height for machining. With the arm and jaw fixed, indexing is, of course, performed by removing the gear and turning it.

When it is proposed to finish the teeth by endmilling with a cutter running in the lathe chuck, the gear must be mounted on the slide rest or vertical slide. For the slide rest mounting, as at *B*, the mandrel can be from square stock, and the arm (at *A*) can then be a plate with a jaw functioning on the same principle. The reaction block for the slide rest clamp can supply the fixing for the plate; and, as before, indexing can be effected by taking off and turning the gear.

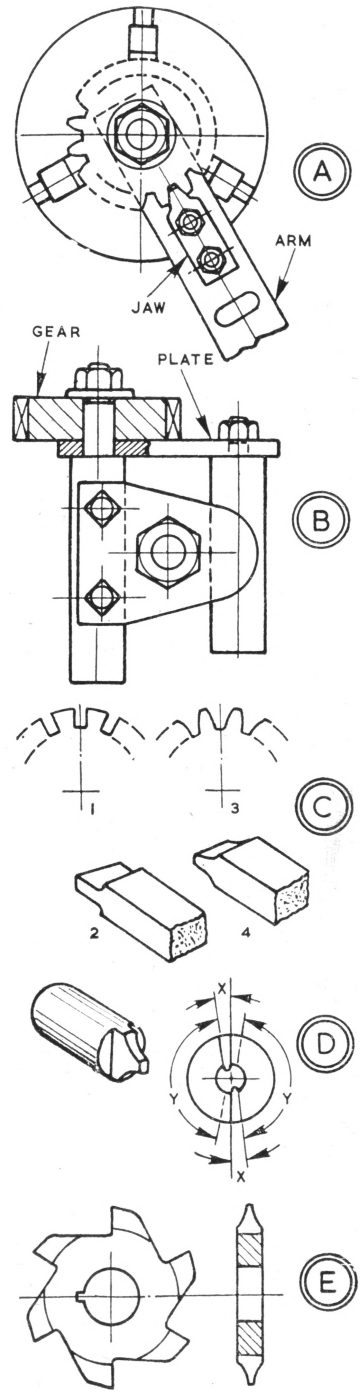
**Using slotting-type cutter**

If the tooth-finishing operation is to be done with a slotting-type gear cutter, the set-up must be on an angleplate on the vertical slide, with the gear lying flat, and a vertical upfeed bringing it past the cutter running on a mandrel in the chuck—possibly with tailstock support. The principle of clamping and indexing can be similar to that of the two previous mountings—and with appropriate adaptations mountings can be made on shaper or milling machine.

Before planing teeth to profile, whether the spaces have been completely filled in or partly produced by sawing and filing, a plain slotting operation, as at *C*1, using tool 2 is advisable to remove surplus material. The cross slide, of course, provides feed, and the saddle the cutting stroke. Subsequent cuts finish the profile as 3 with tool 4—which tool must be filed to fit the teeth, given clearance, hardened and tempered (or ground), and in use carefully regulated for depth of cut. Lubricant may be helpful on occasion, as can easing of the feed on back strokes.

An endmilling cutter, as at *D*, can be made by turning silver steel rod to profile, filing flats and giving clearance. For improved front rake on the teeth, two grooves *X* may be ground along the profile on the blank, followed by backing off through angles *Y* and giving clearance.

The slotting-type gear cutter, as at *E*, is machined with the profile on its edge; then teeth can be formed and given clearance by sawing and filing. ▣



**The lady herself demands attention as work progresses on the model clipper**

# CUTTY SARK

## By Edward Bowness

*Continued from 15 May 1958, pages 622 to 624*

THERE are still a few items on the poop which need our attention, one being the rail along the break. This has a mahogany or teak rail along the top, and is supported by six turned wooden pillars which are carried through the rail and have a round head on top. The rail itself is half-checked to fit the forward side of the cabin companionway as shown in Fig. 20 (April 3). The rail may be seen in the picture of the break of the poop on page 482 in the issue of April 17.

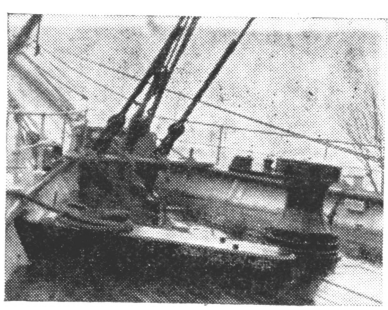
A strip of brown plastic $1\frac{5}{16}$ in. long × $\frac{1}{16}$ in. wide should be used for making the rails, and pins for the pillars as already described for the fife rails in section 4 (April 3). Turned brass pillars would be ideal, but as the height to the underside of the rail is only $\frac{3}{16}$ in. this is scarcely a job for the beginner—unless he is a watchmaker.

### RAILS ON CABIN TOP

The rails along the top of the cabin should be fitted now as they will be inaccessible when the mizen rigging is set up. There are five stanchions on each side and a rail along the top, the ends being turned down and pushed into the cabin top. Both stanchions and rails are made of fine wire which should be tinned. Cut ten pieces each $\frac{5}{16}$ in. long for the stanchions and, after marking holes for them with the point of a needle, press them into the cabin top in the positions indicated in the plan Fig. 20 (April 3). To ensure their being of equal height a jig should be made (see Fig. 28), and used as shown in the drawing.

The jig is made from a piece of steel or brass $\frac{1}{8}$ in. or 10 s.w.g. in thickness. Cut a step 7/32 in. deep in one corner for the rails on the cabin top and steps $\frac{3}{16}$ in. and 5/32 in. in two of the other corners. The $\frac{3}{16}$ in. step is for the rails around the poop and the 5/32 in. step for the rails on the fo'c'sle head. The jig can be used for all three sets of rails providing the correct step is used. If the steps are cut while making the jig they will be ready for use when required.

When the stanchions are in position, bend the top rail to shape so that when the ends are pressed into holes in the cabin top the wire is lying in contact with the tops of the stanchions. With a suitable soldering iron, touch the rail at each point where it contacts the stanchions. A steady hand with a light touch is necessary but, given this, it is not difficult to make a firm joint at each point.



*Fo'c'sle head: capstan and port cathead*

### HARNESS CASKS

There are two harness casks on the poop of *Cutty Sark*, one on each side of the companionway as shown in the plan (Fig. 20, April 3). They were used for the storage of salted meat, and are made of oak clamped together with brass hoops which were kept polished. They are about 3 ft high and 2 ft 6 in. diameter at the base tapering toward the top (see Fig. 29). They should be turned from brass wire 8 s.w.g. or 5/32 in. dia. wooden dowel. If they are turned from brass wire they should be painted brown with narrow strips left bright to represent the brass hoops.

There are eight fire-buckets stored in racks under the rail at the break of the poop, but at $\frac{1}{16}$ in. scale they are so small, and owing to their position so inconspicuous, that they could well be ignored.

### FORECASTLE HEAD FITTINGS

We can now direct our attention to the fittings on the fo'c'sle head. For the catheads prepare a strip of boxwood or similar hard close-grained wood $\frac{1}{16}$ in. square, and taper it down on one side for a length of $\frac{5}{16}$ in. until the end is 1/32 in. thick. Cut it off squarely making it $\frac{9}{16}$ in. long. Make a second piece similar to the first. Drill a $\frac{1}{16}$ in. dia. hole through the bulwark on each side level with the deck and file it out to $\frac{1}{16}$ in. square.

The catheads must then be pushed through the holes and glued to the deck with $\frac{1}{4}$ in. projecting as shown in section in Fig. 30. Their positions can be scaled from the deck plan Fig. 20 (April 3) in which it will also be seen that they are set at right angles with the line of the bulwarks.

### CAPSTAN

For the model, the capstan is approximately $\frac{3}{16}$ in. high, $\frac{1}{8}$ in. dia. at the head and 5/32 in. at the base. Its general form will be seen in the picture of the fo'c'sle head on this page which also shows very clearly the inner end of the port cathead. The capstan should be turned from a piece of boxwood or from a short length of 8 s.w.g. brass wire. If the capstan is made of wood, the whelps, of which there are six, should be made of thread and glued on, but if it is of metal a length of fine brass wire should be bound axially about the capstan and then pressed in closely to the waist (see Fig. 31) and finally dipped in a bath of solder. The larger diameters are then cleaned up in the lathe, after which it can be parted off, leaving a short plug which will be pressed into a hole in the deck in the position shown in the plan Fig. 20 (April 3).

### PIN RAIL

There is a short pin rail across the bows of the ship just aft of the knightheads which has holes for four belaying pins. This should be made from a strip of plastic $\frac{1}{16}$ in. wide glued across the topgallant rails as shown in the deck plan (Fig. 20). Just aft of the pin rail there are two fairleads fixed on top of the topgallant rail. These are shown in plan and elevation on Fig. 20 and may be seen in the photograph of the bows on this page. Incidentally this photograph was taken when the restoration of the ship was completed whereas the somewhat similar one on page 289 (March 6) was taken considerably earlier. The fairleads consist of three vertical rollers, the outer ones being

supported by outside brackets and the centre one by an upright pin. In the model the base is $\frac{1}{4}$ in. long $\times$ $\frac{1}{16}$ in. wide and the rollers are less than $\frac{1}{16}$ in. high. A simplified form may be made out of plastic as shown in Fig. 32, the central roller being represented by a projecting pin which secures it in position after it is glued to the rail. There are smaller and simpler fairleads on the rail around the poop, but they are scarcely noticeable and could be ignored.

## BREAK OF THE FO'C'SLE

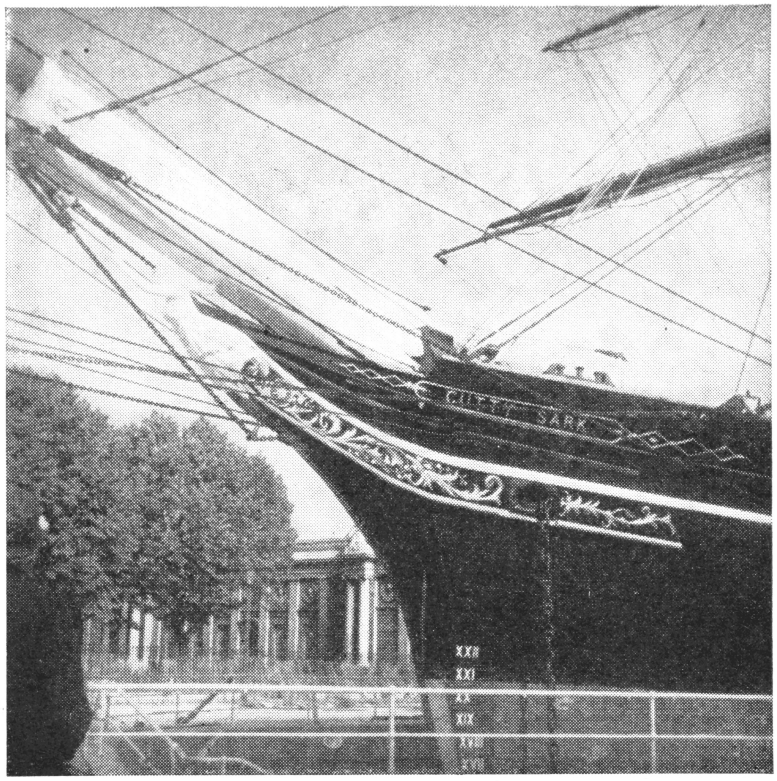
There are two pairs of bollards at the after end of the fo'c'sle head. They are similar in size to those on the poop and could be made at the same time and in the same way.

At the after edge of the fo'c'sle head where it is cut away above the windlass there are four stanchions 7/32 in. high and two short lengths of railing which should now be fitted. They are clearly shown in the picture on page 482 in the issue for April 17. Two stanchions are to be seen at the head and two more at the foot of each of the companion ladders leading down to the main deck. These have eyes to receive the ropes which take the place of rails, but at our small scale I consider it better to continue the upper wire down on each side of the ladders. Note the gap aft of the samson post through which projects the bracket which carries the ship's bell. For the model the bell is about $\frac{1}{16}$ in. high and $\frac{1}{16}$ in. dia. across the mouth, quite a tiny affair, and the bracket which carries it is even more delicate to make, so I think it could well be omitted from the model.

The swivelling socket on top of the samson post should, however, be represented. Its form will be seen in the photograph on page 482 in the issue for April 17. It consists of a double-ended socket mounted on a trunnion with a horizontal pin. In the model the socket could be filed from a piece of brass wire $\frac{1}{4}$ in. long $\times$ 20 s.w.g. filed square and tapered toward each end, or alternatively it could be made from a piece of boxwood. The trunnion bracket should be made out of tin or thin card and cemented on top of the samson post with the socket in position. If the socket is tilted slightly it helps to explain its working. A thin wire on each side could be stuck into the deck and glued under the socket to represent the operating rods. The handles should be lashed to the rail as shown in the photograph on page 482 as if they were put in place in the sockets they would be liable to damage. They should be made of brass wire 24 s.w.g. They are about 6 ft long overall and the handles 4 ft end to end.

## ANCHORS

Two anchors should be shown on the fo'c'sle head. There would be a third bower anchor on the ship but it would be stored under the fo'c'sle head or in the 'tween decks, and so it will not show in the model. The kedge and stream anchors are smaller and are not found in conspicuous positions; they should, therefore, be omitted from the model. When I first saw *Cutty Sark* one of her anchors had an iron stock and the other the old-fashioned wooden stock. If the modeller cares to copy this it would add a little interest; the decision is left to him. At present both anchors have iron stocks.




*Port bow: figurehead, headwork and decoration*

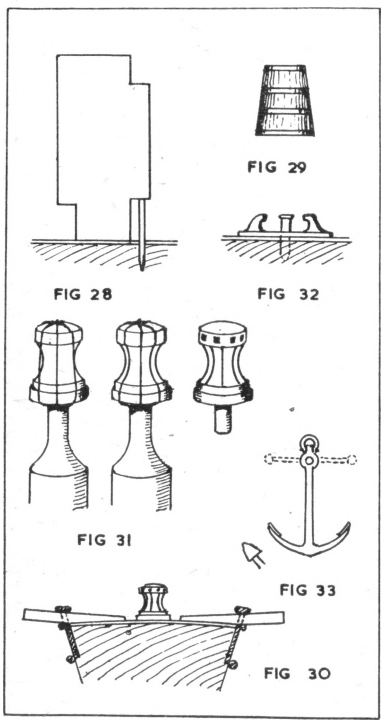



*Fig.* 28: *Jig for rail stanchions*; (29) *harness casks*; (30) *section through fo'c'sle head showing cat-heads*; (31) *putting Whelps on the capstan*; (32) *fairleads on fo'c'sle head*; (33) *anchors*; *and* (34) *starboard bow showing figurehead and decoration. Figs.* 28, 29, 31 *and* 32 *are shown twice full size*

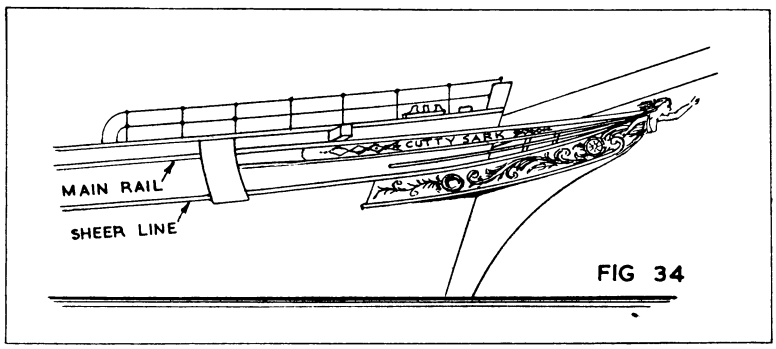
For the model, the anchors will measure $\frac{5}{8}$ in. long overall and the stock should be just under $\frac{1}{2}$ in. long. The anchors could be filed from 16 s.w.g. brass sheet with the flukes soldered on (see Fig. 33) or they could be carved from a sheet of plastic. A hole must be drilled for the stock which should be of 20 s.w.g. wire. A ring or shackle should be fitted to take the anchor cable, which will be discussed later. In the meantime the anchors should be laid away until the time comes for putting them in position.

## EXTERIOR DETAILS

To complete the hull there are a number of external details which must be attended to. To begin with the sheer line—in my model I made this of thin fishing line, 1/32 in. or slightly less in diameter. The diameter can be measured by winding say four or eight coils on a stick, pressing them closely together and then measuring across them, and dividing by the number of coils. The sheer line runs around the ship, from the figurehead around the counter and back to the figurehead. It can be used to cover the joint between the bulwark and the main deck. Before fitting it, two strips of thin Bristol board should be cut to fit the cheeks, extending from the figurehead to where they blend with the sides of the ship; they are glued in position. To prevent the cord slipping off the knuckle, which is the angle under the counter, drive a few pins into the hull immediately below this to hold the cord in place until the glue sets. Give the cord a good coating of glue and lay it in position along the hull, holding the ends tight at the bow and allowing the ends to project where the figurehead will come. When the glue has almost set, press the cord up or down as may be necessary until it runs in a smooth flowing line parallel to the top-gallant rail throughout its length. This is very important. The ends will be trimmed off when making the figurehead.

The main rail, which is the moulding next above the sheer line, should then be fixed in position, using a somewhat finer cord. A few pins will be required for this also to hold it in position where it passes around the counter. The cord should be stretched tightly around the corners of the knight-heads until the glue has set. It will be cut off to length when fitting the name boards.

The moulding along the lower edge of the trail boards, which are glued on the cheeks, must also be fitted before making the figurehead. Using the thinner cord which was used for the main rail, cut off two lengths and glue them in place taking especial care to have them lie in a true curve. Their forward ends should be curled around and upwards as shown in the photograph of the port bow in this issue, and in Fig. 34.




*Starboard bow, showing figurehead, headwork and decoration*

## THE FIGUREHEAD

We come now to the figurehead and the decoration at the bows. At present the bow is in the condition shown in Fig. 6B (March 6) with the addition of the ply-wood bulwark up to the forward edge of the knight-heads. To make the figurehead, first drill a very fine hole in the top of the projecting piece at the stem head and insert an ordinary household pin until the head is almost, but not quite, down on the wood. Twist a short piece of fuse wire around it under the head leaving the ends projecting on each side. Apply some modelling wax such as Barbola around the pin and down on each side as far as the scroll, and model it with a blunt pointed instrument into some semblance of a figure with draperies. Alternatively, Durofix could be used as it can be modelled as it sets, and when the first layers have set others can be added and the figure gradually built up. The head of the pin will, of course, be covered, but little or no resemblance to a face can be expected at this scale, the actual size being that shown in Fig. 34. The fuse wire is embedded in the moulding where it encircles the pin, and some resemblance to the shoulders should be attempted. The projecting wire on the port side should be drawn forward and upward to simulate the **left** arm and that on the starboard side bent down alongside the figure for the right arm. A suggestion of the hair will help to give the head and shoulders the upward and forward attitude which is required. With a little care a reasonable impression of the figurehead with its outstretched arm can be given. The draperies should be worked around the scroll on the trail boards. The ends of the cord which forms the sheer line should be worked into these draperies as shown in the title illustration and in Fig. 34. The photograph in this issue also illustrates this.

## DECORATION AT THE BOWS

At the bows are two additional rails between the main rail and the sheer line, dividing the space into three almost equal parts. The upper of these rails extends as far aft as the bill boards which protect the hull from the wear and tear which is inevitable when securing the anchors. The billboards can be made of Bristol board glued on the side across the sheer line and the main rail as shown in Fig. 34. The name boards fill the space between the main rail and the uppermost of the two intermediate rails. They should be made of thin three-ply or plastic, and glued to the underside of the main rails, being secured at their after ends to the bulwarks and forward to the figurehead. The lower of the two rails could be made of brass wire flattened toward their after ends where they are cemented to the bulwark and fixed into the figurehead at their forward ends. Small triangles of card or plastic should be glued across between them under the bowsprit to secure them in position.

The design of the name boards and the trail boards is shown in Fig. 34 and in the photograph of the bows. The scroll on the trail boards is gilded and could be worked up in thread glued on, or it could be merely painted and touched up with gold leaf or paint.

The name and the decoration around it are gilded. The sheer line is painted white and the main and topgallant rails are left in the natural colour of the wood, then they are varnished.

● *To be continued*

# A century of models

**This article, first of a series by JOSEPH MARTIN, will be of particular interest to London visitors who are including the Science Museum in their itinerary**

"God bless my dearest Albert. God bless my dearest country." So wrote Queen Victoria in her diary during the hectic May of 1851.

The Great Exhibition was drawing the four corners of the world to Hyde Park. Fundamentalists who feared that such a display of pride would call down wrath from Heaven; earnest Anglicans who suspected that Jesuit agents would be sowing Popery among the crowds; the politically nervous who were convinced of a plot to assassinate the Queen; doctors who feared an outbreak of plague; manufacturers who vowed that the country would be ruined by foreign goods and foreign ideas; and the old ladies of both sexes who knew that all foreigners were by their nature immoral and wicked—these pessimists, and others with them, had been forgotten overnight. Prince Albert's exhibition was the wonder of the age.

Flocking to the fabulous palace of glass which a great railwayman had designed in seven days and seven nights, East and West together, the old nations and the new, paid homage to the Machine; and above all to the steam locomotive, the idol of the temple in a century that worshipped Progress. Here, talking of steam, were the New Men of Great Britain and the emergent United States—the railway magnates, the factory millionaires, the bustling engineers, and the holidaying apprentices in their Sunday serge and gay cravats.

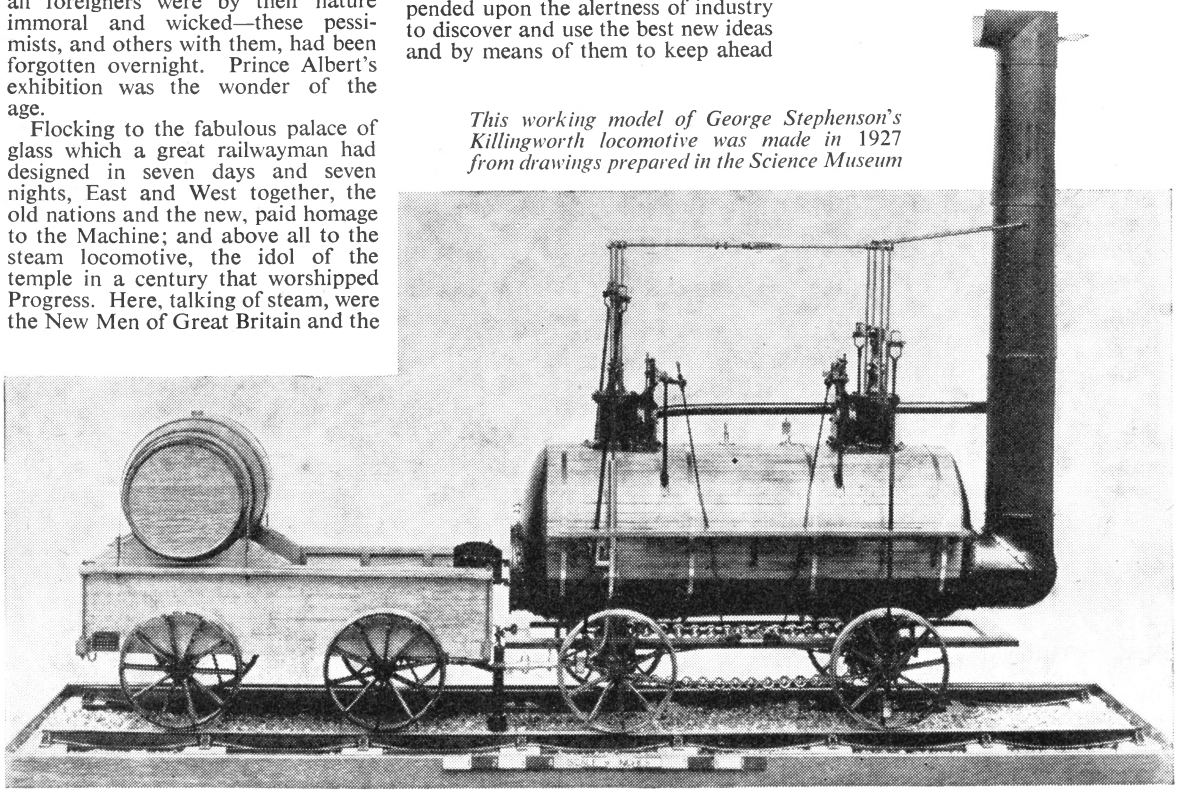
The Great Exhibition remained open for 23 weeks and was seen by 6,170,000 people. Many thought it a pity that so much should be collected and then dispersed again. Did all these marvels and treasures, 11 miles of them brought together by 15,000 exhibitors, have to disappear from public view when the Crystal Palace closed its doors for ever?

More important still, was the educational purpose of the exhibition to be lost? The mid-nineteenth century was in some ways curiously similar to the mid-twentieth. Then as now, the prosperity of Britain depended upon the alertness of industry to discover and use the best new ideas and by means of them to keep ahead of its overseas competitors. All this meant education: more scientists and technicians were needed and the artisan could no longer be a peasant with a different set of tools.

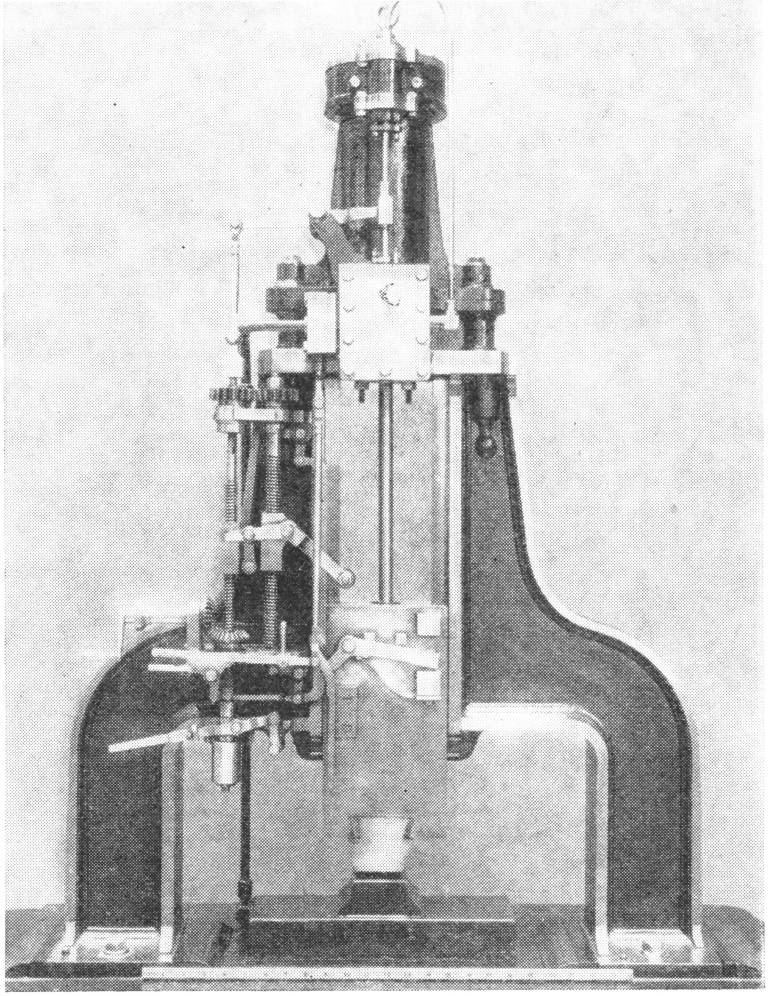
The educational value of the exhibition was beyond doubt. No one, not even old Mary Kelynack who trudged up from Newlyn to see it all before she died, could fail to gain something from that vast array; and what the young gained, far beyond the knowledge that they assimilated, was an inspiring confidence in the Machine.

Surely all this was worth continuing? The Prince and his Commissioners felt that it was. They had money in hand, an agreeable profit of £186,000, and with this support for

*This working model of George Stephenson's Killingworth locomotive was made in* 1927 *from drawings prepared in the Science Museum*



*Crown copyright—Science Museum*



*Crown copyright—Science Museum*

*Nasmyth's original steam hammer, one of many model tools on view*

their idea they proposed the establishment of an institution which—how much like today this sounds !—"should serve the means of industrial education and extend the influence of Science and Art upon productive Industry."

The Treasury gave its approval to a Department of Science and Art which at first belonged to the Board of Trade and was transferred in 1857 to a committee of the Privy Council on Education. By that time the Crystal Palace itself, instead of having a brief life as a temporary structure in Hyde Park, had come to be one of the most familiar landmarks in the London area. In a somewhat altered form, it stood on Sydenham Hill for 85 years, a memorial to Joseph Paxton, the 2,000 workmen who had laboured to build it, and the age whose wonders it had housed.

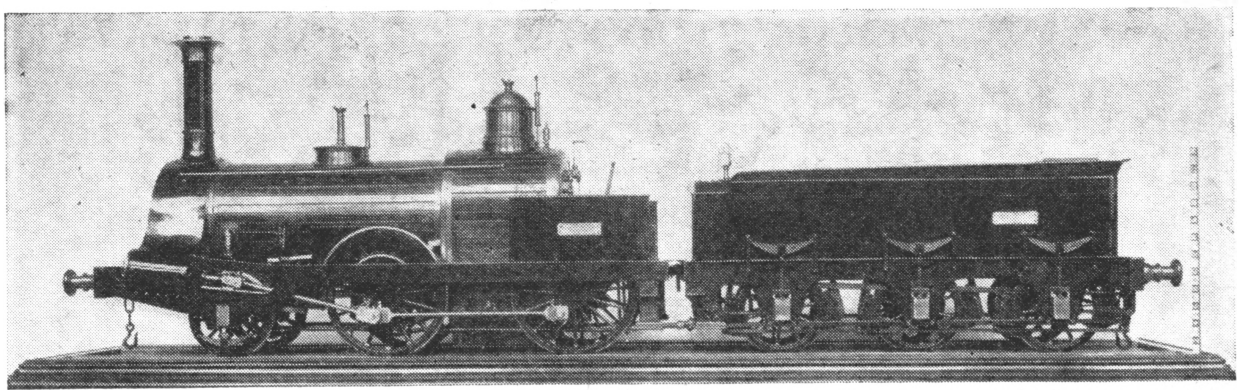
Parliament granted £50,000 for the purchase of objects from the Great Exhibition, and these acquisitions together with others from the Government School of Design were housed in a corrugated iron building at South Kensington where Prince Albert and his fellow sponsors had bought 30 acres of land. Last year was the centenary of the opening by Queen Victoria.

Although the Victorians believed tremendously in Science, the conception of the scientific attitude as Sir Humphry Davy understood it had not yet percolated through society. The primary value of Science was thought to reside in the service that it gave to industry, and we find this view expressed in the pioneering science collections at South Kensington.

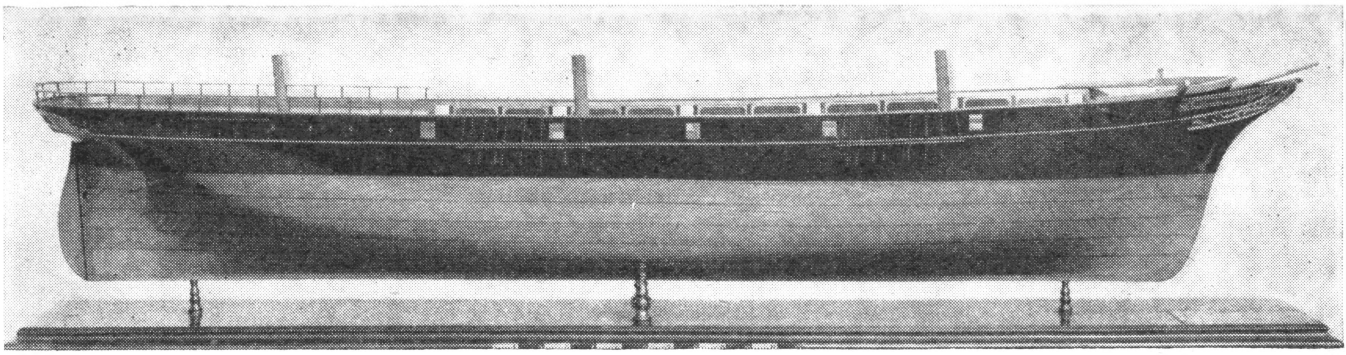
They included, very prominently, a display of educational equipment for teachers—with price-lists provided! A visitor in those days was much more likely to be impressed by a chair made of coal (there was one in the Great Exhibition) than by Arkwright's spinning machine. Anyone who could go home to Cornwall or Cumberland with the tale of a coal chair was as sure of an audience as Marco Polo.

As the years went by, the character of the collections changed. In 1864 naval models and marine engines were added. This nucleus of what is now a delightful section began with the loan of models from the Admiralty. When the Admiralty withdrew them

*Below: This model of an Allen engine built for India in 1856 came to the Museum 95 years ago*



*Crown copyright—Science Museum*



Crown copyright—Science Museum

*Who can fail to admire the lines of this hull, modelled from the* FIERY CROSS *of* 1860 ?

to Greenwich in 1873 there was enough left, from various additions which had been made, to ensure that ships and their equipment would have a proud place in the Science Museum. Many of these models are still there, after 90 years.

Since 1857 the South Kensington site had contained a collection formed at the request of the Commissioners of Patents by Bennett Woodcroft, Superintendent of Specifications at the Patent Office. Some of the models and full-scale machines in the Patent Museum, as it was usually known, belonged to the Commissioners, some to Bennett Woodcroft himself, and others to various private persons. With the passing of a new Patents Act in 1883 the Commissioners' machinery was transferred to the Science and Art Department, the actual move taking place in the following year.

The widely-held belief that the Science Museum grew from a great number of prototypes and models lodged with the Patent Office is, like most widely-held beliefs, not quite true. Bennett Woodcroft's collection was by no means confined to patented inventions. It included, for instance, the *Rocket* and *Puffing Billy*, which today are, perhaps, the most famous of all the Science Museum exhibits.

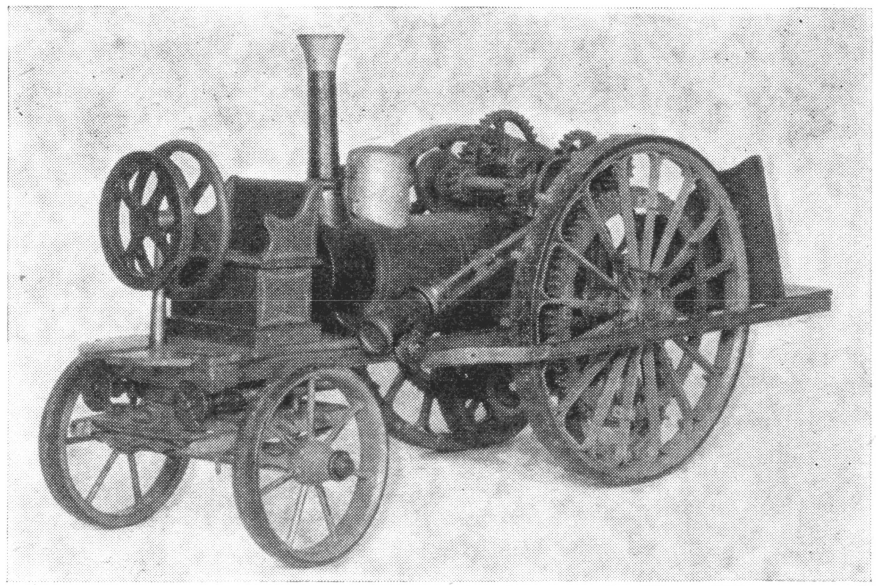
In 1900, when the Maudslay company went into liquidation after contributing nobly to the engineering progress of the world, the Science Museum was enriched by the magnificent Maudslay collection of marine engine models and machine tools. Three years later the engine models and portraits collected by Bennett Woodcroft himself, and relating to the great creative period from 1803 to 1879, gave further interest to a display which was obviously bound to go on growing year by year.

As by a natural process, the Science Museum marched with Science itself. However, much was added, something new was always making its claim to inclusion. The development of the internal combustion engine, the endless applications of electricity, the arrival of powered flight—all these demanded space. Entirely new sciences pressed for admission.

Early in this century Sir Hugh Bell's Committee called for a great expansion, together with many other improvements—among them the inclusion of as many working models as possible. In these recommendations the Science Museum of today had its birth. The Bell Committee envisaged it as a museum of "incalculable benefit" to intellectual progress and industrial development, an institution of which the country might well be proud.

No one can visit the Cromwell Road area today without feeling that London is a greater city and a nobler capital for having the Science Museum and the other institutions which stand near it: the Victoria and Albert Museum, the Natural History Museum, the Imperial Institute, the Geological Museum, the Imperial College of Science and Technology, the Royal College of Science, the Royal School of Mines, the City and Guilds College, the Royal College of Art, and the Royal College of Music; all inspired by that superb Victorian confidence in education which was exemplified by the Crystal Palace and, more enduringly, by the corrugated-iron building which Queen Victoria opened 101 years ago for that earnest, humourless, much misunderstood great man who was her husband. ▣

*She ran in* 1859. *The model was received three years later*



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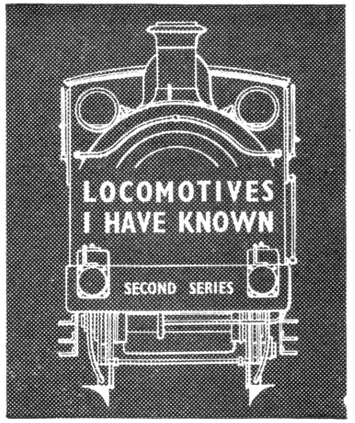



*By J. N. MASKELYNE*

# LNWR EXPRESS PASSENGER ENGINE No 1 "CLIVE"

No 1 *Clive* was one of the memorable Precursor class designed by George Whale for the LNWR and introduced in 1904. She was one of several No 1s that I knew; but my interest in her was very strongly personal, and for reasons that I will mention later, if only because of one of the most astonishing coincidences that could ever have happened to anyone.

The Precursors were of interest because not only were they intended to provide the LNWR with some express passenger engines to replace the notorious Webb 3-cylinder compounds that Whale was scrapping at such a furious rate, but the design had to be simple and quite straightforward, and the engines had to be quickly and cheaply built and at the same time powerful and more in keeping with the then modern ideas.

To achieve these very desirable and urgently-needed ends, Whale produced what was virtually an enlargement and modernisation of Webb's redoubtable 2-4-0 Precedent class [ME, 17 May 1956]. The new engines, externally, were neat, bold and very nicely proportioned, and I have no hesitation in placing them among England's most handsome 4-4-0s.

From the technical point of view, they were typical of their period in being plain, 2-cylinder simple engines with inside cylinders and good boilers, but no superheaters. The cylinders were 19 in. dia., 26 in. stroke and had the valves on top, operated by Joy's valve gear. Particulars of valve setting, port sizes and so forth, have never been available; but they must have been very good, because the engines brought about what amounted to a revolution in the general standard of LNWR locomotive performance. All the same, the exhaust beats gave out that characteristically uneven tattoo that was the mark of the Joy gear—two dashes and a couple of dots per revolution of the driving wheels !

What mattered most was that the first engine of the class, No. 513, *Precursor*, completed in March 1904, had not been in existence a week before she had shown quite clearly that, at last, the LNWR possessed a good express engine—so good, in fact, that the company's directors had no hesitation in giving their consent to Whale's request that large numbers of similar engines should be built as quickly as possible. Crewe works got going to such effect that, between June 1904 and May 1906, no fewer than 110 of these fine engines had been built. Twenty more, bringing the total to 130, were added between June and August 1907; No 1, *Clive*, was the first of this final batch.

There can be little doubt that the boiler design, next to the extraordinary simplicity of the whole engine, contributed much to the success of the Precursors. The barrel contained 309 tubes of $1\frac{7}{8}$ in. dia., and was made in three rings, the diameters of which were 4 ft $11\frac{1}{2}$ in., 5 ft $0\frac{3}{4}$ in. and 5 ft 2 in. The pitch was 8 ft 5 in. from rail level.

The firebox, outside, was 7 ft 4 in. long and 4 ft 1 in. wide, at grate level, while its depth below the boiler centre line was 6 ft 3 in. The grate area was 22.4 sq. ft. The heating surface of the firebox was 161.3 sq. ft, and that of the tubes was no less than 1,848.4 sq. ft, making the total 2,009.7 sq. ft—a remarkable figure for a 4-4-0 engine of *any* period, let alone 1904 ! The working pressure of the boiler was 175 p.s.i., the usual pressure for LNWR express locomotives for many years.

The tubes were not so crowded as might have been supposed, because the boiler barrel was quite large, and the firebox very high; in fact, the distance between the tops of the two casings was about 1 ft 4 in. Nevertheless, the water range and steam space were decidedly limited, though I believe that there was never a recorded case of a Precursor being short of steam.

The wheelbase was 6 ft 3 in. plus 8 ft $10\frac{1}{2}$ in. plus 10 ft, totalling 25 ft $1\frac{1}{2}$ in., while the overhang at the front was 2 ft 6 in., and at the back 4 ft 3 in. As with the Webb 4-cylinder compound 4-4-0s, the leading truck was not a bogie but a 4-wheeled radial truck with wheels 3 ft 9 in. dia. The coupled wheels were 6 ft 9 in. dia.

In working order, the engine weighed 59 tons 15 cwt, with 21 tons 15 cwt resting on the leading truck and 19 tons on each of the coupled axles.

The tender was a novelty for the LNWR in that its framing was of steel, thereby breaking away from the former Crewe practice of making tender frames of timber. Its capacity was 3,600 gallons of water and $6\frac{3}{4}$ tons of coal.

As might be expected, and in fact was definitely intended, the Precursors were powerful and speedy. They immediately found favour with the men who had to handle them. There was no difficulty in timing trains of 300 or more tons weight on 55 m.p.h. schedules, even between Crewe and Carlisle; and a very noticeable feature of Precursor work was that, even with heavy trains, good speed could be maintained on up-grades, so there was no need for furious pace on the down-grades.

Engine No 1, *Clive*, was, of course, named after Clive of India. I had a younger brother who, because of family associations, was also named after him. During the 1914-18 war my brother served as an officer in France. And this brings me to the curious coincidence I mentioned.

One afternoon in 1916, my office telephone rang, and on picking up the receiver I was surprised to hear my brother's voice on the line. He asked me to advise the family that he was unexpectedly in London for a few days and would be home later that evening; and he mentioned that he had just been appointed adjutant to his regiment.

About an hour afterwards, going home on the Bakerloo Tube, I did a thing I had never done before and do not remember doing since. I overran my station and found myself at Queen's Park instead of Kilburn Park.

Now, Queen's Park station is alongside what used to be the LNW main line, and during not more than a three-minute wait for a train back to Kilburn Park, an up express came by—a very long train headed by two Precursors. Imagine my feelings when I noticed that those two engines were No 1, *Clive*, piloting No 675, *Adjutant* !

I had known both these engines for some years, and I knew them for several years afterwards; but that evening at Queen's Park was the only occasion when I saw them together, or even in the same place at the same time.

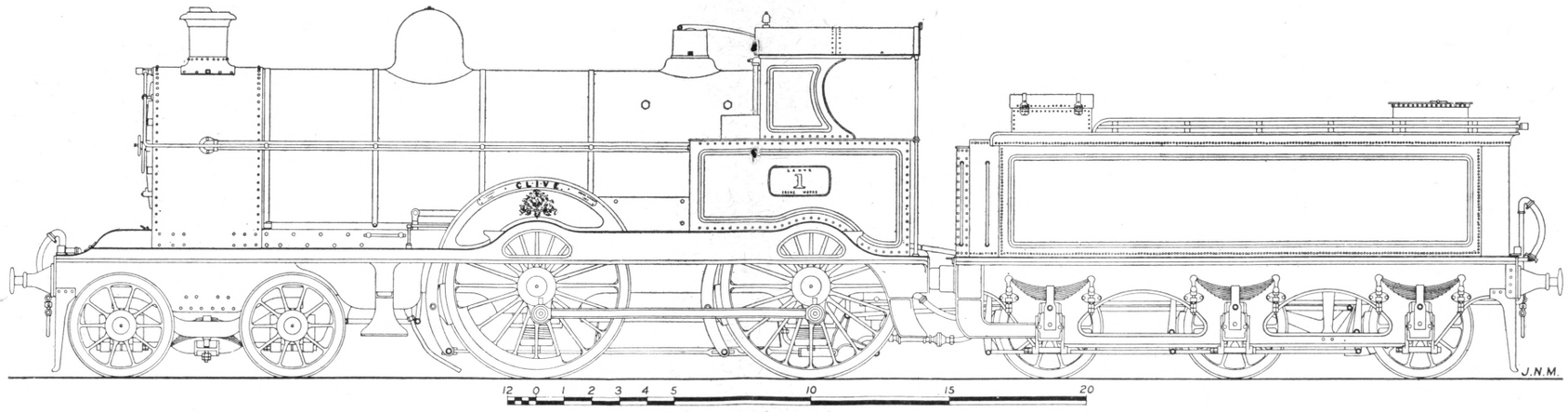
As I am writing these notes, one of *Clive's* nameplates is in front of me. It is quite a massive piece of brass, $\frac{3}{16}$ in. thick, $2\frac{1}{2}$ in. wide, approximately 4 ft 6 in. long and curved on a radius of about 3 ft 6 in. The name, in the characteristic LNWR capitals, the company's initials, the Crewe Works title and the engine's date are all sunk into the surface of the plate and filled in with black wax. I have never weighed it, but I think it must weigh some 25 to 30 lb. A curious little detail, which was common to all LNWR nameplates, is the full stop which appears after the name.

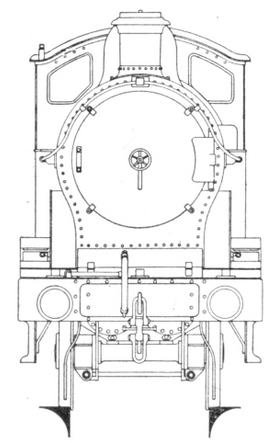
This nameplate is, of course, one of the two which the engine carried for upwards of 30 years, and it shows little sign of maltreatment. Its general condition is quite good. I acquired it about 20 years ago, and I keep it as a memento, not only of a curious experience but also of a very lovable locomotive.

A detail worth mentioning is that all the nameplates of the Precursors were the same length, no matter whether the actual name was a short one like *Arab* (No 2576), or a long one like *Richard Trevithick* (No. 1650). I believe that this was the first instance of the adoption of a standard length of nameplate, and it remained the usual practice at Crewe ever afterwards.

Several readers have asked for the dates of my earlier articles. Here are the first 20:

1. GER T19 2-4-0 express passenger engines, 23 February 1956.
2. Metropolitan District Railway No 34, 8 March 1956.
3. The LBSCR *Arundel*, 22 March 1956.
4. Great Western Railway No 1, 5 April 1956.
5. The Great Central Atlantics, 19 April 1956.
6. Midland Railway's Kirtley tanks, 3 May 1956
7. The North Western Jumbos, 17 May 1956.
8. GWR No 34, 31 May 1956.
9. The SE and CR No 512, 14 June 1956.
10. The LBSCR 4-4-2 No 23, 28 June 1956.
11. Caledonian Railway No 123, 12 July 1956.
12. Great Western Railway *Madras*, 26 July 1956.
13. LSWR 2-4-0 tank engine No 0298, 9 August 1956.
14. Central London Railway Nos 1 and 2, 23 August 1956.
15. Lancashire and Yorkshire Railway No 718, 6 September 1956.
16. Great Western Railway No 999, 20 September 1956.
17. LBSCR *Holyrood*, 4 October 1956.
18. North London Railway's 4-4-0T No 20, 18 October 1956.
19. Midland Railway 800 Class 2-4-0, 1 November 1956.
20. Great Eastern Railway 2-4-0 No. 1, 15 November 1956. ■



# PANSY

**LBSC gives instructions for making and fitting the guide bars, crossheads and connecting rods for the 5 in. gauge pannier GWR tank engine**

*Continued from 8 May 1958, pages 602 to 604*

THE back covers are turned in similar fashion, but the register must fit the bore exactly, and after facing, centre and drill it ¼ in. for the piston rod. After reversing and parting off the chucking-piece, face the gland boss and open out the hole to a full ⅜ in. depth with a 29/64 in. pin-drill; tap ½ in. × 32.

Tip for beginners—always use a pin-drill for opening out stuffing-boxes. An ordinary drill frequently runs out of truth when opening out a smaller hole, and naturally the tap follows it. The result is that when the gland is screwed in, the holes in gland and stuffing-box don't line up, and the rod binds.

The piston-rods are 4 in. lengths of ¼ in. ground rustless steel with ¼ in. of ¼ in. × 40 thread on one end. The pistons can be turned from drawn bronze rod, or castings, but if you can beg, borrow or—ah, um ! otherwise acquire a couple of scrap auto-engine alloy pistons from your local garageman, melt them down (a plumber's iron ladle plus a big blowlamp or the domestic boiler fire with the blower on will be needed for that job) and pour the molten metal into a short length of cardboard tube a little bigger than 1½ in. dia.

Note, this must stand on a *perfectly dry* stone or firebrick.

Locomotive pistons turned from this alloy will not only last the lifetime of the engine, but will work with the least possible friction. The alloy pistons on my gas-buggy went up and down the cylinders so many millions of times before showing appreciable wear, that I am using the metal for both pistons and piston valves.

Whatever kind of metal selected, chuck it in the three-jaw and turn about 1½ in. length to about 1/32 in. over finished diameter. Face the end, centre, and drill to ⅝ in. depth with 7/32 in. drill. At ⅛ in. from the end, cut a groove ¼ in. wide and a full ¼ in. deep. Part off at a full ½ in. from the end, and repeat operation. Chuck one of the embryo pistons with the parted end outwards, face to correct length, open out the hole to ¼ in. depth with ¼ in. drill, and tap the remainder ¼ in. × 40. Put a piston rod in the tailstock chuck, screwed end outwards, run it up to the piston, enter it and pull the belt by hand until right home. The plain part of the rod in the plain part of the hole ensures a true fit, like the way chucks are fitted to precision lathes.

To finish turning the piston, grip the rod either in a collet or a split bush held in the three-jaw, and with a sharp round-nose tool, take off a little at a time until the piston fits the cylinder bore without a vestige of shake. It should slide easily. Pistons turned thus will be quite steamtight without being mechanically tight, and there isn't the slightest need for honing, grinding, or any other fancy fitting, provided that the lathe is reasonably accurate, and workmanship up to average. Incidentally some good folk make a lot of unnecessary fuss about piston fits and such like jobs.

Any of the girls in the munition shop of which I had charge during the latter part of the Kaiser's war, could have machined up *Pansy's* cylinder casting and fitted the pistons accurately while dreaming about absent boy friends, dance frocks and other things dear to all feminine hearts, so no beginner need be scared of the job !

The guide-bars, crossheads and connecting-rods shown in the accompanying drawing are very little different to those shown on the drawing of the full-size job which I have here, and the dimensions are as nearly proportional as I can get them with due regard to strength and wear-resisting properties, so I hope that they will meet the approval of the good folk who are building *Pansy*.

For the guide-bars, four pieces of ¼ in. × 7/16 in. steel will be needed, each 4¼ in. long after the ends have been squared off. I usually do this job by gripping the whole lot in the four-jaw chuck and facing the ends all at once, which ensures that they are all exactly the same length. One side of each bar is then milled or filed to the contour shown, and drilled for the screw holding it to the boss on the cylinder.

Tip for beginners—don't fit the bars permanently to the cylinders before fitting the crossheads. It isn't exactly unknown for an unskilled tyro to make a pair of crossheads with the grooves for the guide-bars slightly out of line. If the bars are fitted to suit, it makes no appreciable difference to the working of the engine, and a sixty-fourth or so isn't noticeable. More experienced workers can attach the guide-bars to the bosses by a 5/32 in. or 3 BA screw in each; take care to keep the bar up tight against the cylinder cover while locating the hole for drilling and tapping.

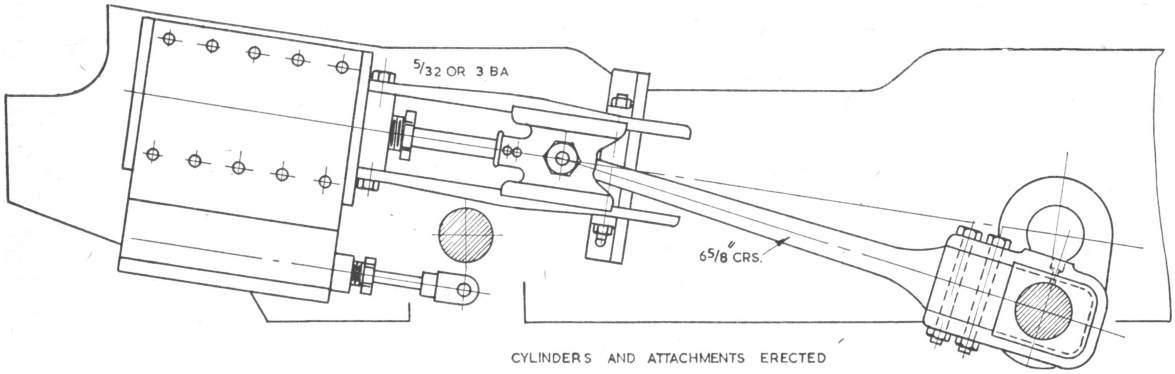
## CROSSHEADS

The crossheads may either be cast or built up. If cast they will most likely be in nickel-bronze (German silver) which works very well on steel guide-bars. Very little machining will be required. Any roughness on the outside can be removed with a file, but the grooves will need a spot of milling. If a regular machine is available, just grip them in a machine vice on the table, and run them under a 7/16 in. side-and-face cutter on the arbor.

If a cutter of this size isn't available, use the nearest size smaller, and take two cuts, using a piece of steel of the same section as the guide-bars as a gauge. It should slide easily; a wee bit of side-play makes no difference, but the distance between the bottoms of the grooves should be about right, otherwise the crosshead will rock, and cause excessive wear on both gland and piston-rod. I check with my slide-gauge, setting the jaws the same distance apart as the guide bars.

If the casting is turned over without shifting the table of the milling machine, the grooves will be exactly opposite. To get them parallel I put a piece of thin steel bar with parallel edges between the jaws of the vice, letting it rest on the runners. The crosshead is held down on this while tightening the vice jaws, and when the other groove has been milled out it is always parallel to the first one.

The grooves can be milled out in much the same way in the lathe, by holding the crosshead in a machine




CYLINDERS AND ATTACHMENTS ERECTED

vice (regular or improvised) on the saddle, and running it under a cutter on an arbor between centres. It must, however, be packed up to correct height, as the saddle has no vertical adjustment. The process described for endmilling axleboxes in the recent "Ways and Means" article can also be used.

When drilling for the pin, take great care to drill squarely across the two sides, otherwise the connecting rod won't be parallel with the piston rod, and you'll have big ends running hot. Drill 19/64 in. and ream $\frac{5}{16}$ in. It is also advisable to locate the hole in the boss for the piston rod from the piston gland itself, which is easily done.

Take off the cover, put the crosshead between the guide-bars, clamp it temporarily tight up against the gland, and put a $\frac{1}{4}$ in. drill through cover and gland, making a good deep countersink on the crosshead boss. Remove the crosshead and drill the countersink 15/64 in., taking care to set the crosshead perfectly vertical in the machine vice by applying a try-square to the groove. Then enter the "lead" end of a $\frac{1}{4}$ in. parallel reamer in it, just far enough to ensure that the boss fits on the piston rod very tightly.

## BUILT-UP CROSSHEAD

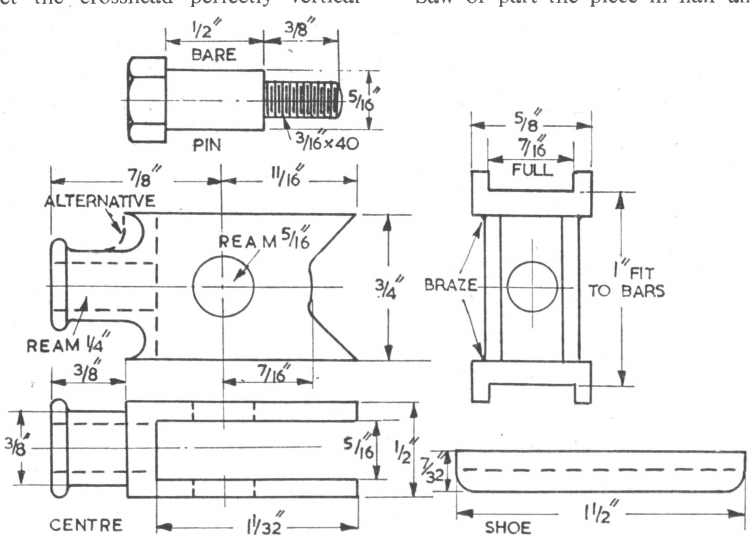
I usually build up crossheads of the type shown in a simple way, making the centre part from a piece of steel bar and the shoes from a piece of smaller section, the whole being brazed together. In the present case the two centre pieces can be made from a single piece of $\frac{1}{2}$ in. × $\frac{3}{4}$ in. mild steel bar a little under $3\frac{1}{2}$ in. long. Chuck truly in the four-jaw, face the end, and turn as shown in the drawing. The half-round recesses can be formed with a bent roundnose tool, but it makes no difference if they are left out altogether and the end finished off square. Centre the end and drill to $\frac{1}{2}$ in. depth with 15/64 in. drill. Reverse and repeat operation.

Saw or part the piece in half and slot out each half to $\frac{5}{16}$ in. width, either by running it under a side-and-face cutter in the milling machine or lathe, or by endmilling as for axleboxes. It is advisable to mark out and drill the crosshole for the pin before slotting, but the reaming can be left until the crosshead is finished. File the end to the shape shown, making certain that the length is correct.

Two pieces of $\frac{1}{4}$ in. × $\frac{5}{8}$ in. mild steel each about $3\frac{1}{4}$ in. long are needed for the shoes. In each of these, mill a groove $\frac{7}{16}$ in. wide and $\frac{1}{8}$ in. deep, by any of the processes mentioned. Cut them in half and trim to $1\frac{1}{2}$ in. length, but don't bother about rounding them off until after the brazing job. To hold the shoes to the centre while brazing, I use a rough home-made cramp similar to a toolmaker's cramp—it would give any toolmaker the cramp to glance at it, being just two bits of $\frac{3}{8}$ in. square steel held together by two stove screws! Anyway, it does the trick.

The shoes are set at each side of the centre piece, lined up, and the lot held together by the cramp, the jaws of which rest in the grooves in the shoes. Wet flux is laid along the joints, the whole heated to bright red, and a bit of soft brass wire, or a $\frac{1}{16}$ in. Sifbronze rod, is applied to the joints between shoes and centre. This will melt and run along the joint in a neat fillet if the heat is right. Warning—don't overdo it and let any brazing material run inside the cavity; if it does, the little end of the connecting rod won't enter, and it's a nobby old job to chip it out!

Quench the lot in clean cold water, remove the cramp and finish off the ends of the shoes with a file, scrape any scaling out of the recess, and clean up the whole issue with fine emerycloth. Put a $\frac{5}{16}$ in. reamer through the hole for the crosshead pin, and ream the hole in the boss to a tight fit on the piston rod. Take a shade off the top and bottom of each shoe, to bring the overall width of the crosshead to $1\frac{3}{16}$ in. When pushed




BUILT UP CROSSHEAD

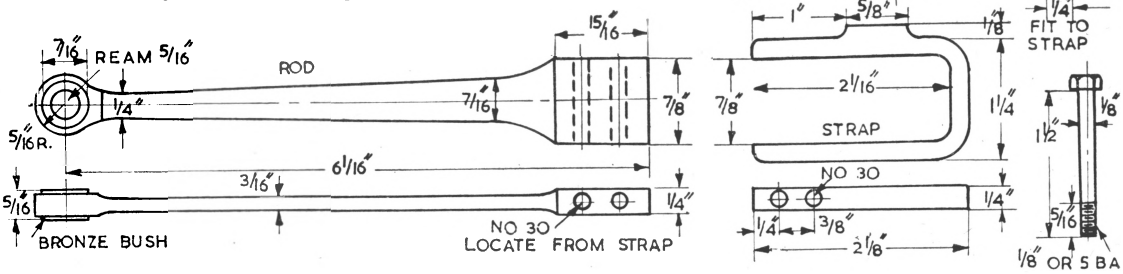
up against the piston gland, it should fit easily between the bars without appreciable shake.

The easiest way to make crosshead pins that will resist wear, is to use ground silver steel of the requisite size, $\frac{1}{16}$ in. in the present case. Chuck a piece in the three-jaw and turn $\frac{3}{8}$ in. length to $\frac{3}{16}$ in. dia., screwing $\frac{3}{16}$ in. × 40. Part off at $\frac{11}{16}$ in. from shoulder, reverse in chuck and turn a full $\frac{3}{16}$ in. length to $\frac{3}{16}$ in. dia., screwing as before. Make the nuts from $\frac{7}{16}$ in. hexagon steel, screw one tightly on the shorter screwed end and slightly rivet over the projecting bit of thread. The longer screwed end is needed for carrying the arm for driving the crosshead pump.

The connecting rods are slightly simplified versions of the full-size article, which has a strap-type big end with brasses adjusted by a taper cotter. There is no need for the taper cotter in the little engine's big ends. When the brasses wear, they can be let together by filing a little off the butt faces, and putting a shim between the end of the rod and the brasses. If the shim is soldered to the end of the brass it can't fall out.

The rod itself is made from $\frac{7}{8}$ in. × $\frac{1}{4}$ in. mild steel, and can be milled to shape by the method described for coupling rods. One of the illustrations in the "Ways and Means" article showed the method of setting up the job for milling the taper. The little end is drilled $\frac{7}{16}$ in. and furnished with a bronze bush which should project a bare 1/32 in. at each side and should be a nice fit in the recess in the crosshead. The drawing shows the centre part of the rod thinned down at each side as in full-size, but anybody wishing to save work can leave the rod full thickness from end to end. The working of the engine isn't affected, and the rods are not conspicuous.

The best way of making the strap is to rough-saw it from a slab of mild steel measuring $1\frac{1}{2}$ in. × $2\frac{1}{4}$ in. and $\frac{1}{4}$ in. thick. Coat the steel with marking-out fluid, mark the outline very plainly, and drill a $\frac{5}{16}$ in. hole at each corner of the closed end. Then saw down each side to the hole, and cut the bit between the holes with a piercing-saw or an Abrafile. The inside of the jaws can be milled or filed to fit nicely over the rod end, and the outside of the upper jaw milled or filed to leave the part forming the oil box. When drilling the bolt holes, take care to mark them off exactly opposite each other, and drill them on the centre line of the strap.

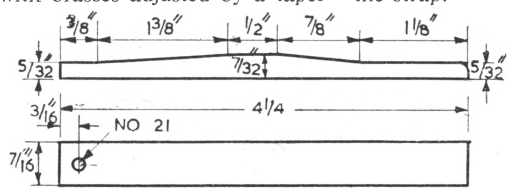



CONNECTING ROD

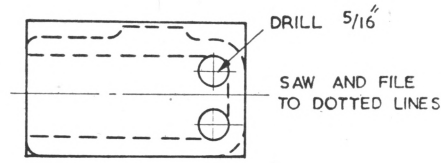
The brasses are made from bronze (it's that Pat again !) and I make mine in the following way. Chuck a piece of $\frac{5}{8}$ in. × $\frac{3}{8}$ in. section in the four-jaw, and part off four 1 in. lengths. Solder two of these together to form a rectangle $1\frac{1}{4}$ in. × 1 in. Mill a groove $\frac{1}{4}$ in. wide and $\frac{1}{16}$ in. deep along both longer sides and one shorter side, in exactly the same way as described for milling axleboxes. The remaining shorter side has $\frac{1}{16}$ in. milled off it, bringing the overall width to $1\frac{1}{8}$ in.

Round off the corners of the grooved end with a file, and trim the sharp corners of the groove to suit, so that the block fits nicely into the strap, as shown in the assembly drawing. Put it in place, and fit the end of the connecting rod in the jaws, butting them tightly up against the brasses. Hold the assembly together by any convenient means, then put a No 30 drill down the holes in the strap and drill halfway through the thickness of the end of the connecting rod.

Turn the lot over and ditto-repeato the drilling, so that the holes meet in the middle.




GUIDE BAR




HOW TO CUT STRAPS

Anyone who fancies his skill at what a juvenile friend calls "bendification" could make the straps from $\frac{3}{16}$ in. × $\frac{1}{4}$ in. mild steel strip. It is quite easy if a piece of bar $\frac{7}{8}$ in. wide is used as a guide. Round off the corners to 5/32 in. radius, then bend the piece of strip around the end of the bar. Mild steel is ductile enough for cold bending, but it bends easier if made red hot.

A thickening-piece can be brazed on and filed up to form the oil box, or the oil box left off. It won't make any difference, as the big ends are in sight and perfectly accessible, and an occasional spot of oil from the engine-driver's inseparable companion will do everything needed in the way of lubrication. My single-wheeler *Grosvenor* throws what she doesn't need all over the bottom of the boiler barrel, exactly the same as her big sisters did !

● *To be continued*

The Ways and Means article of May 15 bears directly on the construction of the cylinders for *Pansy*, which was being discussed at the close of the May 8 article. This operation continues in this article about the GWR pannier tank, so the Ways and Means article of May 15 must be read in conjunction with the first part of this instalment.

# Traction engine

**In the tenth article Ernest A. Steel comes to the front wheels and the steering gear**

Continued from 15 May 1958, pages 626 to 628

WHEN discussing one of his designs with engineering colleagues Henry Greenly would sometimes observe that " in the concluding process of steam engine construction in general, and model work in particular, whatever arrangement a designer indicates on his drawing, the maker of the machine will usually find it expedient to make some modification if only to satisfy a personal idiosyncrasy." He would add that the model engineer has often to make do with the materials to hand and yet attempt to keep as close as possible to the design.

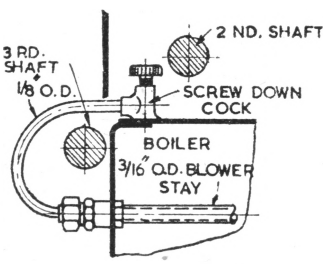



*Fig. 1: Steam supply to blower*

While the setting out of a number of the fittings described last time can usually be left to the builder to decide during the job itself, queries inevitably arise on how various parts can best be fitted in place.

The blower valve is usually fitted at the smokebox end and the steam pipe taken inside to the base of the chimney. Greenly, however, adopted the locomotive arrangement with the steam cock located at the rear of the boiler and the steam pipe connected to a hollow longitudinal " blower " stay. At the smokebox end another short length of steam pipe connects this stay with the base of the blast pipe in the chimney. If space permits, some such arrangement as that shown in Fig. 1 might be considered. Normally the blower is employed only for raising steam, but it can be turned on when the fire door is open and the regulator is closed.

## LEADING WHEELS AND AXLE

For the 1 in. scale model the front axle is of special construction and involves a variety of machining operations not usually encountered in axle construction. The axle is machined from $\frac{3}{4}$ in. bright mild steel bar 7 in. long. Actually, $\frac{5}{8}$ in. $\times$ $\frac{7}{16}$ in. material would be better as it would save material and time in machining. I note that Macready's Metal Co. Ltd of Pentonville Road, London, N1 lists a carbon steel key bar to specification EN 6a to the latter size; this would meet the case.

The axle is machined all over with the exception of the centre portion which, for strength purposes, remains the original cross section of the bar. The end journals are turned down to $\frac{5}{16}$ in. dia. and also screwed $\frac{3}{16}$ in. or 2 BA. The centre hole is drilled 7/32 in. diameter and elongated as indicated in the drawing (Fig. 3).

The combined saddle piece directly beneath the smokebox and centre swivel takes the form of a single gunmetal casting and follows fairly closely the design as fitted to the full-size engine. The saddle portion need hardly be machined; given a sound casting, the top curved face can be filed until a reasonably good fit can be made with the under side of the smokebox. However, the casting will have to be set up in the lathe for turning the two spigots (1 in. and $1\frac{1}{8}$ in. dia.) and the spherical face of $\frac{5}{8}$ in. radius. One modification would be to drill and tap the casting 0 BA or $\frac{1}{4}$ in. BSF for the central pivot pin. This I have shown in Fig. 4.

In this design a prominent feature is the " spud " pan—a large circular flanged casting to which the front axle and steering chains are fixed. Model engineers experienced in turning locomotive wheel castings will have no difficulty in machining the

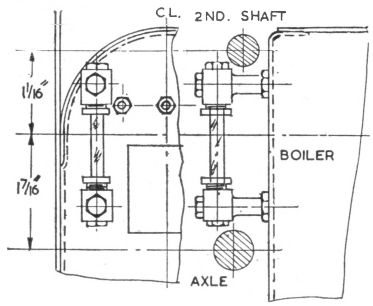



*Fig. 2: Detail showing the space limitations for the water gauge*

casting shown in Fig. 5. It is suggested that it could be machined in the lathe all over. Alternatively, the pan can, of course, be turned from, say, a 4 in. dia. steel disc about 1 in. thick. This reminds me also that the saddle piece could also be made from stock materials, fabricated in parts and welded together if this should be found to be more convenient. It should be noted that the axle must be securely bolted to the spud pan.

A detailed assembly of a front wheel is shown in Fig. 6. The T-section rim

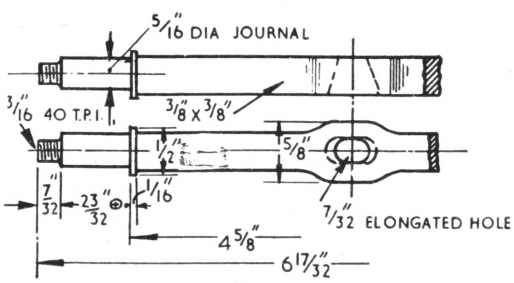



*Fig. 3: Front axle with centre hole*

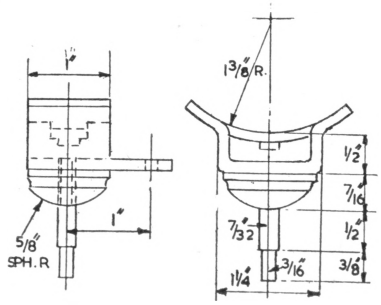



*Fig. 4: The cast saddle and swivel*

may be cast in brass or a good quality cast iron to the dimensions shown. For the turner prepared to undertake a long session at the lathe, this item can be turned out of 4¼ in. round stock bright mild steel bar. Thus by turning an annular groove not larger than 3¼ in. dia. by about ¼ in. wide and 1 in. deep, the tread can either be rough machined or finished to size and then parted off leaving a solid core of metal on the parent bar with but little waste. The partly finished rim is then set up in the lathe for internal machining to the dimensions shown on the drawing.

A detail of the slotted hub is shown in Fig. 7. The central portion is in the form of a double flanged bobbin milled with six 7/32 in. slots 1/16 in. deep on each face, but staggered to take alternately the inner and outer spokes. The outer hub plate is screwed 7/16 in. (26 or 32 t.p.i.) and serves to lock the hub

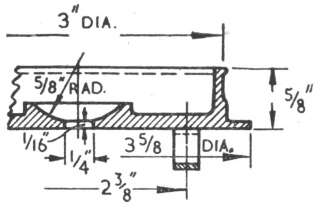



*Fig. 5: The spud pan is prominent*

up solid together with the spokes. The assembly and alignment of the complete wheel should be carried out with the aid of a special jig and similar to the arrangement described for the pair of rear wheels. The retaining nut for the axle is screwed 9/16 in. (or 2 BA). Over this an outer cap of polished brass is fitted and secured with three 8 BA bolts.

## STEERING GEAR

Since the boiler is necessarily so much more the basic structure of a traction engine than that encountered with other types of engines, it has been the practice for many years in the history of the road locomotive to attach the chain winding shaft and bearings to the front of the firebox. A similar arrangement is, of course, followed in the construction of the 1 in. scale model, but some difficulty may be experienced when the time comes to align the two castings as shown in Fig. 8. They are machined as shown in the detail drawing (Fig. 9) with the exception of the holes for the shaft.

With the boiler up-ended on the surface plate the bearings are first offered up for marking off in their correct position on the job. At the same time they can be checked for alignment and corrections can be made with suitable shims if it is found that there are any marked inequalities of the boiler plate. Once the castings are aligned satisfactorily the boiler plate can be marked off for drilling and tapping 6 BA. Having assembled the brackets temporarily, a scribing block can be used for marking off the centres of the shaft to the dimensions shown on the drawing. The two castings can now be dismantled with the assurance that on re-assembly the parts will be reasonably accurate or can be made so. The holes for the shaft can now be drilled and reamed to provide an easy running fit for the chain shaft.

The between-bearings dimension given on the drawing is 2 7/16 in., but it would, perhaps, be as well to check this with callipers in the initial setting up, as there may be slight variations either in the dimensions of the castings or in the assembly. The shaft is made of 5/16 in. round bright m.s. having an overall length of 3½ in. for turning the ends. The left-hand side is stepped down to ¼ in. dia. for the bearing, and again to 7/32 in. or 3/16 in., depending on the size of the wormwheel bore. The latter is securely keyed to its shaft. The right-hand side is stepped down to ¼ in. only. Two ⅛ in. holes are drilled in the shaft to receive the chain bolts.

It will be evident that in steering to left or right one chain is wound on the shaft while the other is being unwound. The normal arrangement is for the left-hand chain to be wound over the shaft and the right-hand chain to be wound round under it—both leading from the outside inward to connect up to the two bolts in the middle.

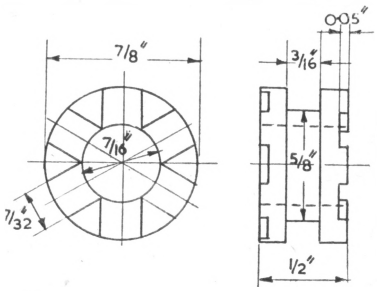



*Fig. 7: Front wheel hub;*

The setting out of the worm gear is shown in Fig. 10. In the original design of 1933 it was suggested that a Meccano worm and wormwheel would be the most applicable type to use for this small model. The ratio is given as 28:1 which is a somewhat slow one for such a gear. A more usual ratio was 18:1, but I have counted 17 and 20 wormwheel teeth on a number of makes of traction engines and all meshing with single-start worms. Bond's list shows a worm gear having an 18 to one ratio; the bronze wheel being ⅞ in. dia. and the steel worm 7/16 in. The wheel teeth are correctly generated in manufacture, which reduces frictional resistance to a minimum provided they are assembled in correct mesh with the worm. It should be noted that if Bond's gear is fitted, the shaft centres must be increased from 9/16 in. to 0.604 in., an increase of 0.042 in. Further, the wormwheel can be either reamered out to 7/32 in. or the appropriate end of the shaft turned down to 3/16 in. to suit the bore of the wheel. The worm is bored to take a 5/32 in. shaft.

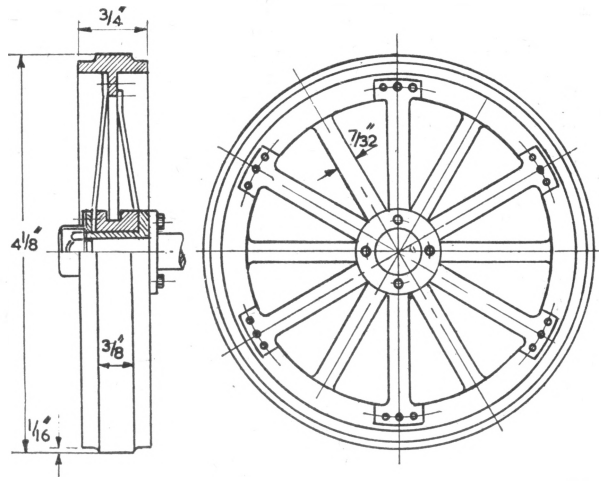



*Fig. 6: Detailed arrangement of a front wheel*

In the fitting of the water gauge difficulty is likely to be experienced in the initial setting out on the boiler backplate. An arrangement considered as the only practical one in this case is shown in Fig. 2, but it leaves little space for a pressure gauge. The gauge is located directly in front of the third shaft as designed in full-size practice. Special brass mountings are required; the upper one communicating with the steam space extends the barest minimum to clear the shaft. The lower mounting of the same material communicates with the water space and is also extended to bring it in alignment with the $\frac{3}{16}$ in. glass and upper mounting.

On examination of one of the original Paxman drawings the pressure gauge is connected to a header on top of the boiler with the pair of water gauges inclined to form an inverted V, the whole set-up being symmetrical about the centre line of the machine. A single gauge glass is all that is required for the model.

● *To be continued*

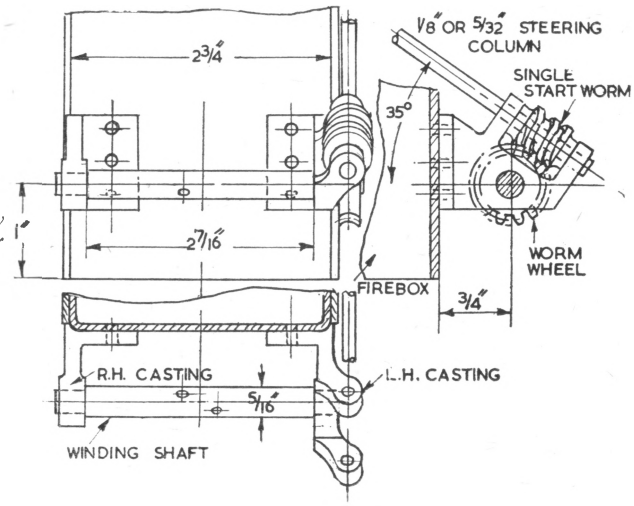



*Fig. 8: Assembly of steering gear*

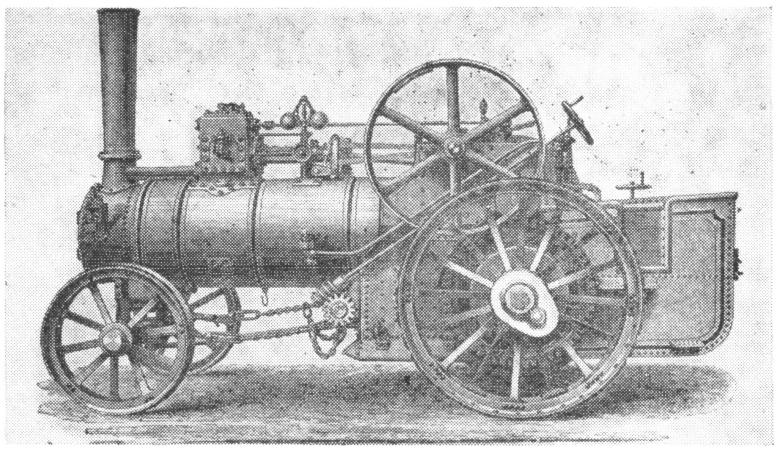


*Fig. 11: McLaren traction engine of 1879 with screw-adjustment shackles fitted to the steering chains*

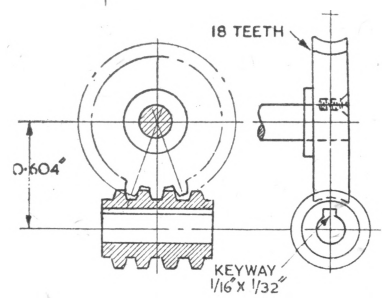



*Fig. 10: Setting out of worm gear*

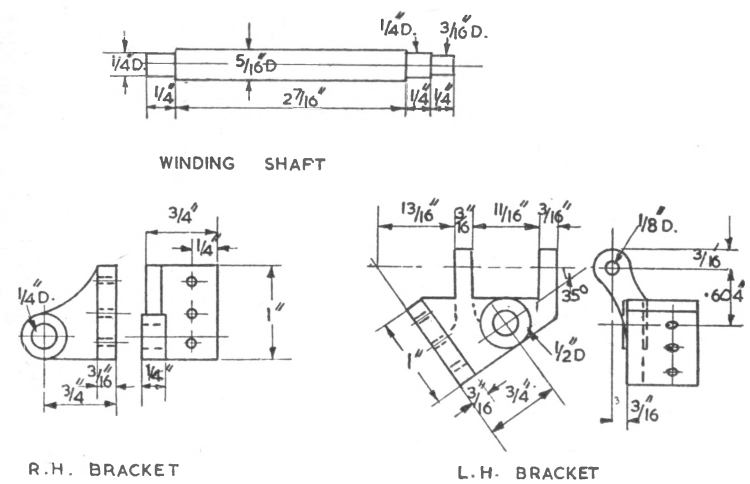


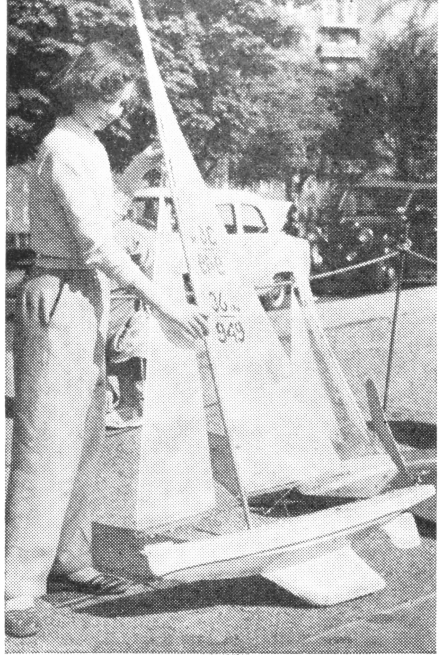

*Fig. 9: Castings for steering gear and steel winding shaft*

## CAPSTAN AND TURRET LATHE HANDBOOK. By F. J. Camm. (London: George Newnes Ltd). Price 25s.

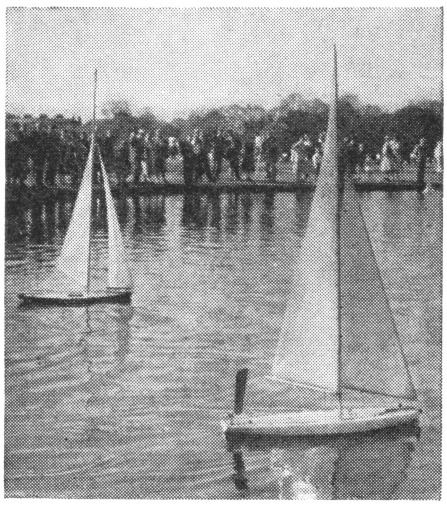
THIS is essentially a book for the production engineer, as the subject matter applies to the methods and equipment used in quantity repetition work for manufacturing industries.

Various types of capstan and turret lathes are described, together with their tools and attachments, including methods of automatically limiting feeds and traverse to produce work of uniform shape and size. Radial and tangential box tools with both roller and pad steadies are described, also various forms of chuck and fixtures for holding work, expanding die heads and other devices for cutting threads.

Cutting lubricants, feeds and speeds, and other practical essentials are comprehensively dealt with. The illustrations are consistently good, and explanations easy to follow.—E.T.W.



*Miss J. Gorst with her boat* HOP-IT



QUACKIE I (*E. Gorst*) *and* UNA *the winner* (*R. J. Burton*) *make a good start*

# The 36 in. R class 1958 National Championship

**The variable wind provided a good test for the skippers, reports EDWARD BOWNESS**

ONLY four clubs and 11 boats took part in the National Championship for the 36 in. Restricted Class, held in London at the Long Pond on Clapham Common. Danson club provided two boats, and Guildford and Forest Gate a single craft each, so that all but four of the entries were from the home club.

It may be that the popularity of the Marblehead tends to undermine the interest in the smaller boat. After all, the 36 in. costs almost as much in labour and material to build as an M Class boat, although it has the advantage of being more convenient for transport owing to its smaller dimensions and weight.

Apart from rather tricky winds, the weather was ideal—bright sunshine without even a threat of rain. On the Saturday the wind was from the north-east, a bad direction for the Clapham pond, as the trees and buildings on the north-east corner create awkward eddies. It was, however, a good test for the skippers, and at the close of sailing H. E. Quennel (*Jennifer*) was in the lead with 41 points, R. J. Burton (*Una*) was only three points behind and E. Gorst (*Quackie I*) and G. H. Goddard (*Danson Minx*) were following with 32 points each.

On the Sunday morning the wind had changed to the south-west, where it stayed all day. About noon it seemed as though it would fall away altogether but it freshened up after lunch and gave a little livelier sailing. By about 4 p.m. only the resails remained to be dealt with. These, as usual, had a considerable effect on the final scores, and H. E. Quennel, who was leading on Saturday evening and for most of Sunday, was just beaten by R. J. Burton, who was runner-up at the close of sailing on Saturday.

Mr Burton's boat *Una* is by no means a new one, having been designed and built by his father before the war. She is planked in mahogany and is a fine piece of craftsmanship. She still uses her original Braine steering gear. Mr Burton is convinced that for that particular pond the Braine gear is in no way inferior to the vane and in some respects is more suitable.

There was another boat with Braine steering gear, K. Sedwill's *Panther*. This was a sharpie of the well-known Mullett design.

Another sharpie, also of Mullett design, was *Hop-it*, skippered by Miss J. Gorst, the only lady competitor and probably the youngest in the event. Both these boats sailed nicely and Miss Gorst finished in eighth place with 40½ points. Her father, E. Gorst, was sailing *Quackie I*, built and originally owned by D. A. MacDonald. She is of the famous Duck type designed by Mr H. B. Tucker. Another Duck was *Danson Minx*, sailed by G. H. Goddard of the Danson club. These boats finished in the third and fourth places, *Minx* with 66 points and *Quackie I* with 62.

The other Danson boat *Vivace*, sailed by D. G. Taylor, was notable for its very tall, narrow sail plan, the luff of the mainsail being, I understand, 61 in. long. The jib was also very tall—within 4 in. of the height of the mainsail.

The event as a whole was much enjoyed by the good crowd of spectators. ▣

## RESULTS

| No | Name | Skipper | Club | Score |
|---|---|---|---|---|
| 470 | Una | R. J. Burton | Clapham | 78 |
| 829 | Jennifer | H. E. Quennel | ,, | 77 |
| 792 | Danson Minx | G. H. Goddard | Danson | 66 |
| 612 | Quackie I | E. Gorst | Clapham | 62 |
| 972 | Poco-Poko | D. Godden | ,, | 51½ |
| 919 | Vivace | D. G. Taylor | Danson | 45½ |
| 930 | Moonglow | A. S. Wright | Forest Gate | 43 |
| 949 | Hop-it | Miss J. Gorst | Clapham | 40½ |
| 704 | Panther | K. Sedwill | ,, | 30 |
| 976 | Grand Slam | R. Bonthrone | Clapham | 28½ |
| 948 | Manor Miss | G. H. Bain | Guildford | 28 |

IN THE ME WORKSHOP

# Brazing hearth and forge

**EXACTUS this week deals with the installation of the blower unit with particular attention to the mounting for the blower**

NEARLY all the parts required for converting the brazing hearth into a forge are commercially available, and there should not be any difficulty in purchasing them.

Any of the well known makes of fractional h.p. electric motors can be used for the power unit. The one illustrated is a Brook 0.166 h.p. running at 1,420 r.p.m.

The blower employed is one obtained on the government surplus market, originally intended as a vacuum pump or "exhauster" on aircraft engines. It is of the sliding vane type, the vanes being positively controlled, and is designed to be spigot-mounted on the engine, and direct-driven by a short shaft, articulated to allow of slight misalignment.

These blowers can be run in either direction, to allow for which the inlet and delivery connections are interchangeable. They are designed to be force-lubricated from the engine oiling system, but for our purpose, where it is sufficient to work at much lower speed and pressure, only occasional oiling is necessary.

In this particular adaptation, the blower is driven from the motor by a V-belt on two Picador V-pulleys. The reduction ratio of the blower to the motor is 1:2, a 2 in. dia. pulley on the motor and a 4 in. dia. pulley on the blower.

The mounting of the blower presented a problem. To be able to fit the complete unit neatly in the framework of the brazing hearth, it became obvious that the blower would need a separate mounting of its own. The question then was whether to fabricate one, using angle iron as the main part, or to make a pattern and use an aluminium casting. I decided on the latter because it is structurally rigid and convenient for machining; also I think that a good clean casting takes a lot of beating for appearance.

Supplied with the blower is a short drive shaft of special design. This was discarded as it was not suitable for my purpose, and a new one was made. The bearing in which it runs is of the commercial self-lubricating type.

To prevent any damage to the blower from foreign bodies entering from the intake, an air filter was made. On a piece of equipment of this nature this precaution is most essential. All the pipework or "plumbing" on the delivery side is made from water-pipe fittings bought from the local builders' merchants. The only item that I made here was a pressure relief valve.

There is a tap for controlling the amount of air required for forge work, situated underneath the pan, and another tap for supplying air to a blowtorch if required. All the piping is $\frac{3}{4}$ in. BSP but the tapped holes in the blower are $\frac{5}{8}$ in. BSP. This size is little used today in water fittings, but you may be able to get a $\frac{5}{8}$ in. to $\frac{3}{4}$ in. BSF reducing nipple, as there are still some odd ones about. Unfortunately I had to make mine.

My first job was to make the pattern for my casting. There was nothing very difficult in it, the appearance being something like an angleplate with two side struts for rigidity. On the outside is a boss, suitably strengthened by four webs, to take the bearing bush, and four pads for the fixing screws.

When I received my casting the first job was to produce a flat surface to work from. The bottom half below the bearing boss was reasonably true, and suitable for a bolting face. Resting this face on two small V-blocks, using them as parallel packing, I clamped the casting to the cross-slide of the ML7. With a fly-cutter held in the four-jaw chuck, the bottom face of the casting was then machined with ease, Fig. 2. The cutting tool was a piece of silver steel hardened and ground.

When this operation was completed, I prepared to mark out the position

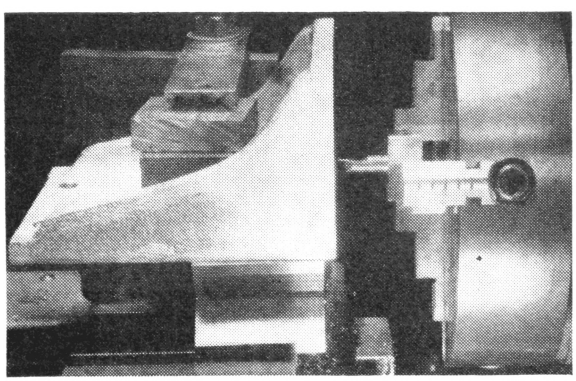


*Fig. 2: Machining the bottom of the casting*

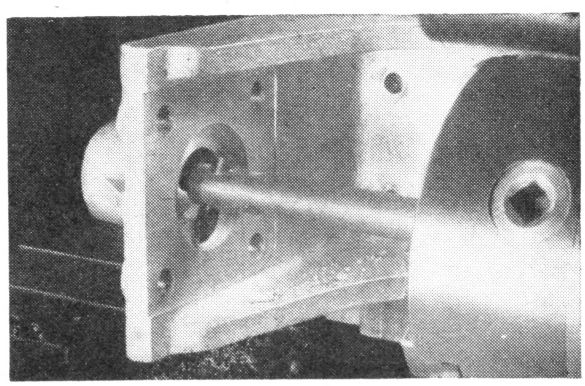
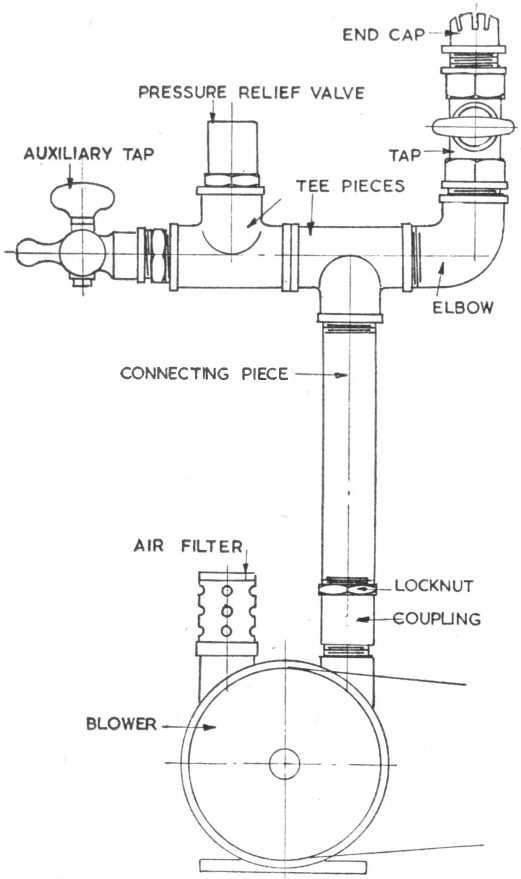
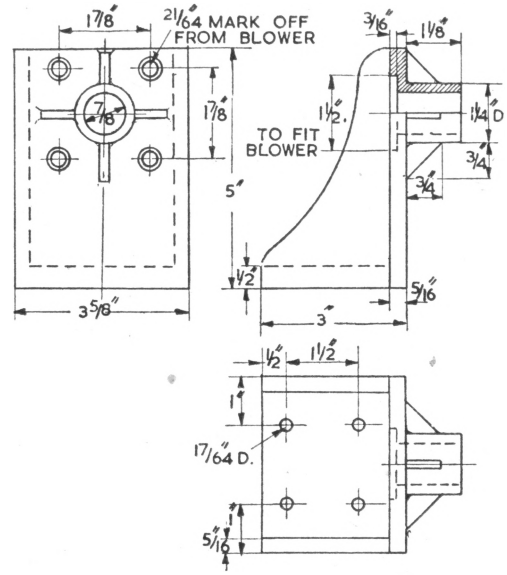
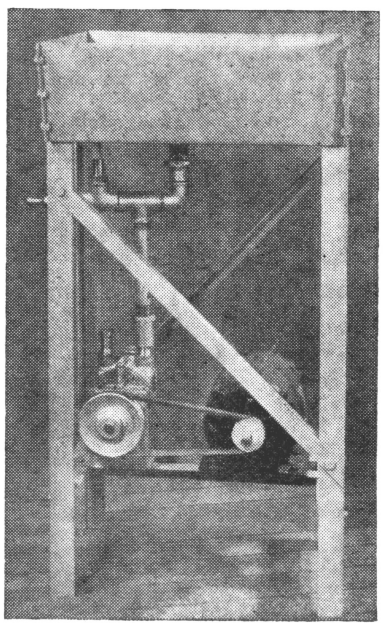


*Fig. 3: Counter boring for the register of the blower casting*




*Left: Diagrammatic layout of the pipework, air filter and the blower unit*



*The forge, showing the blower unit nearing final assembly*

of the bearing bush. All the subsequent machining operations were to be done on the inside of the casting. This meant finding the exact centre of the boss to ensure that the hole would be concentric. The two faces to be marked, the end of boss and the inside of the casting, were coated with Spectra colour so that the lines would show up clearly.

When this was dry, which takes less than a minute, the casting was placed on a surface plate and the scribing block set to the centre of the boss. At this setting a line was then scribed across the inside face of the casting. Then, laying the casting on its side, the same method was used to intersect this line to give the true centre of the boss. A small mark was made with a centre punch to make it more distinguishable for setting up.

Before setting the casting up for machining, I marked the position of the four holding-down screws, because these could be used for securing the casting. The positions are shown on the drawing and were drilled 17/64 in. to clear a $\frac{1}{4}$ in. screw. They were then spot faced with a counterbore, to let the heads of the screws sit square.

I was now ready for setting the workpiece in the lathe. First I bolted the casting to an angleplate, then secured the angleplate to the vertical slide. When all was nicely set on the cross-slide, I was able to get a wide range of traversing movement for the milling operation.

Once the whole set-up was squared to the lathe axis, and all screws tightened, the casting was then positioned for boring. I did this by placing a centre in the headstock mandrel and locating the centrepop mark over it. I commenced the boring by first drilling a $\frac{1}{4}$ in. hole after centre drilling the centrepop. When this drill emerged from the other side of the casting I was able to see quite clearly the position of the hole in relation to the boss. Any eccentricity is easily remedied by adjusting the vertical and cross-slides.

A larger drill was then run through, and if any adjustment has been necessary, a check on the adjustments made can be observed when the drilling is finished.

It was then bored out to suit the Oilite bush and the boring tool used was a piece of silver steel hardened and ground to shape held in the end of a piece of $\frac{1}{2}$ in. dia. bar by an Allen grubscrew. The boring bar was held in the four-jaw chuck to get a finer adjustment for the final cuts

When the hole was bored to finished size, the same boring bar was used to counterbore the hole to the required diameter to suit the register on the blower, and taken deep enough to allow the flange on the blower to be bolted to the casting. The illustration in Fig. 3 shows counterbore nearly finished.

● *To be continued*

This free advice service is open to all readers. Queries must be of a practical nature on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling cannot be given: stamped addressed envelope with each query. Mark envelope clearly "Query," Model Engineer, 19-20 Noel Street, London W1.

# READERS' QUERIES

**DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE OF THIS ISSUE**

## Proportion of weather vane

I would like some advice as to proportion and balance between the pressure end and the pointer in making a weather vane. I understand the best and simplest bearing is a hardened steel point working in a centrepop.—V.R.V., Hastings.

▲ *There is not very much difficulty in the design of the vane as the only really essential point apart from free working bearings, is to ensure that the area of the surface behind the pivot is substantially greater than that in front of it. It is suggested that the pivot should be made fairly long to give good steadying effect and it may with advantage be made in stainless steel. If so, it could be run in bearings of plastic material and these would also take the thrust satisfactorily at the lower end if the vane is not too heavy. A point at about the same angle as that of a drill and working in a blind drilled hole in the plastic material would be suitable for the lower bearing.*

## Adjusting an electric arc welder

I would be much obliged if you could let me know how to adjust output of an electric arc welder to size or thickness of work. Some commercial jobs use taps, also chokes; others slide an iron stamping bridging between coils.—J.S.W., Chelmsford.

▲ *Although a series resistance can be used for the regulation of a welding current, the usual method is to use a choke coil. These coils are either a separate unit or they can be accommodated in the transformer assembly, that is, in the same tank.*

*There is a choice of choke, one being of the tapped class, the other is a plain coil with an iron core; of the two, the sliding core type is the simplest to make, and also the less costly. A choke coil that should suit your application can be an iron core (laminations measuring 3 in. × 3 in. and 14 in. long). The laminations are riveted together along the length of the core.*

*A bobbin is necessary for the coil, and this can be made from about ⅛ in. thick grey fibre, or any similar insulating material: the bobbin can be made in metal, but if this is done the complete bobbin must be sawcut right through so as not to form a short-circuited turn. Bobbin insulation can be to 20 mm. thickness of Leatheroid or oiled Cambric. The winding for this choke can be to 600 turns of 10 s.w.g. plain enamel-covered copper wire.*

*Some means must be provided to lock the iron core in any position along the bobbin, and this is better arranged for if a metal bobbin is used, then one of the cheeks can be made to have a tapped hole at one end for a clamp screw. Adjustment is done by sliding the core in or out of the bobbin, the least amount of current being passed when the core is completely in the coil. To adjust this core for various values, an amperemeter is necessary, then the current values can be marked for the different size rods or values to suit the work in hand. The choke coil is connected in series with the transformer secondary.*

## ME for school boys

The article by Norman Pensam describing his experiences in introducing locomotive building into the school metalwork syllabus was of considerable interest to me because I have for some time been wondering about the possibility of doing the same. I want to avoid starting something which will turn out to be too difficult for the boys to do themselves.

Mr Pensam advises an 0-4-2 arrangement with Baker gear; do you agree? —W.D., Birmingham.

▲ *In view of your desire that the proposed locomotive should be as simple as possible we would strongly recommend that you consider the 3½ in. gauge 0-4-0 tank engine* JULIET. *This engine is extremely popular among amateur locomotive builders because of its simplicity.*

## Boiler too big

My *Tich* chassis is built with loose eccentric valve gear, and I have made the large boiler. When I tried to fit the boiler to the chassis, I found that the ashpan sits on top of the valve eccentrics and that the boiler will have to be set from ¼ in. to ⅜ in. above the level shown in the drawings.

It is obvious from the article and drawings [23 February 1950] that the top of the valve eccentrics must stand higher than the pump eccentric. I do not want at this time to scrap the loose eccentric valve gear and make the Walschaerts gear.—J.T.P., London NW2.

▲ *The large boiler for* TICH *was really intended for the normal version with Walschaerts valve gear—where your trouble would probably not have arisen. We cannot think of any way out other than raising your boiler until the ashpan is clear of the eccentrics. You might be able to take ⅛ in. off the depth of the ashpan without upsetting things too much.*

*We would suggest that if you do raise the boiler centre line, you raise the top of the side tanks by half the amount—i.e. if you need ½ in. more, take ⅛ in. off the ashpan and raise the top of the side tanks by 3/16 in.*

## Looking ahead

Would it be possible to get your notes and drawings sooner than it will take to publish. I am a technical teacher in Glasgow and I have a class of North British Locomotive pre-apprentices who have started to build *Jubilee*. We are now looking forward each week to the articles but it would be better if we knew what was ahead of us. As the class finishes in ten week's time, we would like as much done as possible, then the next class could carry on from there. We have also started *Pansy* by LBSC. —G.M.H., East Kilbride.

▲ *We are afraid that it would be quite impossible to give advance information on* JUBILEE, *as we are building the locomotive ourselves and construction is going ahead only a fortnight in advance of the articles.*

*The locomotive* PANSY *is being dealt with by our contributor LBSC, and here again he is working on the description as quickly as he can but he has many other commitments, technical queries, etc.*

# POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

## ELECTROLYTIC ACTION

SIR,—I do not know all about electrolytic action, I doubt if anyone does, but I have some experience of this trouble in my work as a heating and domestic engineer and also with small locomotive boilers.

Electrolytic action between metals appears to take place only in the presence of acidic or alkaline moisture. If the cladding, dural handrail knobs, and m.s. cab of Mr Savage's engine are dry at the metallic junction, no action should take place. It may surprise many of your readers to know that silicon or manganese (bronze ?) welded joints can fail under the action of certain waters due to the loss of zinc from the deposited metal.

Hot pressed and extruded bronze metal fittings of similar composition used on the local Authority's water supply are failing in a matter of two to three years.

An example of water action such as this is my 5 in. Stirling, which has been used mainly with rain water collected from a roof into a water butt. The threads of the feed clacks into the boiler, when removed last time, completely broke up and showed spongy copper completely denuded of zinc; probably soot off the roof in the water was the aggressor. In my opinion silver, copper or phosphorus alloy should be used for boiler brazing with a generous lap to *all* joints.

Good quality gunmetal, or better still phosphor-bronze, appears to be the answer as regards fittings.

Steel boilers are better all steel and as far as possible all electric arc welded. Careless acetylene welding can cause carbon absorption in the weld and consequent loss of ductility. Stainless steel boilers constructed with welding quality plate and welded with the correct procedure and electrodes should be satisfactory. The stays should be of the same alloy and screwed only; no solder or brazing.

Your American contributor states that an arc weld is porous. Does he not mean that some arc welds are porous due to wrong materials or procedure ? Welding passed this stage many years ago.

I suggest that would-be steel boiler welders test their proficiency by a reverse bend test. A 1 in. wide strip is cut out across the weld of two 3 in. wide plates welded together, all reinforcement removed and then bent over a former 4 × T diameter with the weld root away from the former. The test piece should bend through 180 deg. with only slight cracks at the edges.

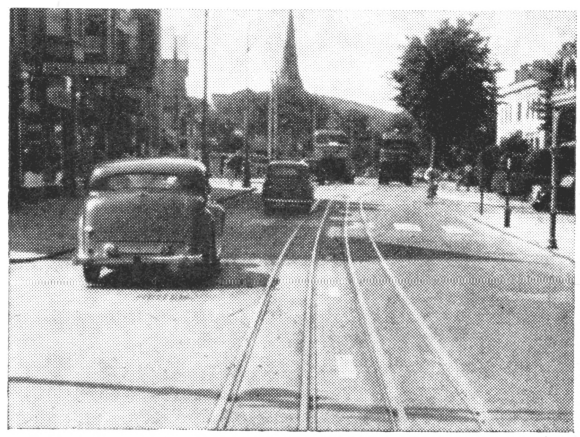
Finally, do not mix metals in boilers, particularly copper with zinc or zinc alloys, aluminium, mild and stainless steel and cast irons, except externally and where dry.

Derby. E. POTTER.

## GAUNTLETING

SIR,—Readers who have a liking for tramways, and especially their rail layouts, will be interested in the accompanying photograph which shows a good example of "gauntleting."

Under this arrangement car routes overlap but do not actually join, rails one and three forming the one track, and two and four the other. In the picture the rails in the distance can just be seen to break apart into normal double track.



*A system for overlapping tramlines that avoids the use of points. The picture was sent by Mr H. A. Robinson*

Gauntleting on tramways (and railways) is used where on account of lack of transverse space it is necessary to bring parallel tracks close together but where the expense or operation of points is not desirable.

In one instance in America the rails of two separate railways were taken over the same terrain for a limited distance by gauntleting, each company looking after its own metals, the roadbed and sleepers being "joint."

Bebington, H. A. ROBINSON.
Cheshire.

## LITTLE STEAMBOATS

SIR,—The interesting article about steamboats in the USA reminded me that among my books is a copy of *The Mercantile Navy List and Maritime Directory for* 1930 (the list of all British registered ships, published by the Board of Trade) whence it appears that these little steamboats existed in considerable numbers in Canada, and in order that they could be insured, etc., were registered as British ships.

For example, I find No 117194 *Erin* of Kenora, Ontario, "built 1905, length 33 ft, breadth 8 ft, depth of hold 3 ft 3 in., net tonnage 9, gross tonnage 14, h.p. of engines, 1."

These little vessels operated on all parts of the Canadian lakes and rivers in the summer; indeed were the only means of reaching many mines and lumber camps, and most belonged to the proprietors of these enterprises.

Of course, these boats carried managers, foremen and light supplies; heavy tugs moved the products to places where the railway picked them up for export.

The "inverted" engine is a good idea for these small boats, as such a length of connecting rod can be got in, and some readers may remember that Messrs Bassett-Lowke used to market one before the war for model boats up to 4 ft long. It had a "banjo" connecting rod all in one piece.

One has also this practical advantage, that as the glands face upwards, leakage from them is at once

obvious, while from the manufacturing point of view, the planing of cross-head guides was dispensed with, and the centre of gravity was reduced. There was less weight of metal in the standards also. These were important points when this Payne power unit was made.

In fact, it is a "table engine" of the type so much used on land at the same period, and as built in England by Maudslay for many years; its only difference is in the U-shaped casting supporting the cylinder, instead of the "table" and four pillars of the stationary engines.

The requirements for machine tool capacity in making this type of engine are so small that it appears an amateur could build one without much expense.

London NW7. H. H. NICHOLLS.

## THE ARCHIBALD RUSSELL

SIR,—Regarding the article of criticism by E. Bowness on J. S. Kamp's $\frac{1}{16}$ in. model of the *Archibald Russell*, the members of my society wish to point out that Mr J. S. Kamp states that he built his model from E. Bowness's book *Modelling the Archibald Russell*. If Mr Bowness would familiarise himself with his own book he will find, facing page 37, a photograph showing the *Archibald Russell* with an accommodation ladder on the port side facing forward, as depicted by Mr Kamp in his model.

The members of our society would like to compliment Mr Kamp on his model.

Greenwich and District SMS. J. B. JENKINSON.

*Mr Bowness writes*:

*I cannot think how I could have overlooked the accommodation ladder in the photograph to which Mr Jenkinson refers, especially as I must have used it when I went aboard the ship on that occasion. I have a distinct recollection of boarding the ship by means of a rope ladder on other occasions. Most of us make mistakes at one time or another. All the same I regret the error, and offer my sincere apologies to Mr Kamp.*

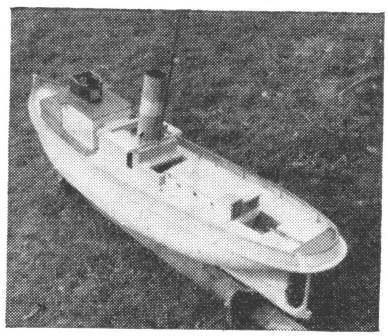
*When I saw the photographs of Mr Kamp's model I was very favourably impressed with it, hence its use on the front cover of* MODEL ENGINEER *for February 6. But the accommodation ladder seemed a bit strange. I felt sure that it was more usual to have it sloping aft, and also that such ladders were not very often used in the later sailing ships when they were trading.*

*In all my writing I have tried to help improve the standard of ship modelling and to encourage the ship modeller. Incidentally, Mr Kamp sent the photographs with the request that I would give him my candid opinion of the model, which I did. Indiscriminate praise helps nobody and I have never descended to it.*—EDITOR.

## BUILDING MODEL TUG

SIR,—I was very interested in the articles by Mr C. Blazdell on his steam tug *Energy*.

I am enclosing a photograph of my tug. I am building (not completed yet) a model of the *Gondia*, the plans of which were supplied by the Percival Marshall Plan Service, and enlarged to 63 in. The hull is of ply; bulkheads,



*Mr Pither's tug ready for painting and awaiting the fitting of the engine*

covered with one-millimetre ply. I gave the whole hull a coat of 306 Aerolite, laid on linen, two layers of the preparation. The finish is like fibreglass. The boat was not painted at the time the photograph was taken. The wheel bridge and foredeck are planked in teak, $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. I am now making the boiler and Stuart compound engine.

This is my second attempt. The first was a sub-chaser, which won a HC award in London, in 1954.

Christchurch. C. PITHER.

## WINTER STARTING

SIR,—I am afraid that Mr McHugh who recently gave a talk to Leyland Motors [ME, March 27] has had his leg pulled or else that he has been misquoted.

The measures he describes to start engines in cold weather are more than a little exaggerated, at least at a mere 60 deg. F of frost. After all, this is only 28 deg. F below zero, at which temperature any engine in reasonably good condition will start easily without any external aids, other than what we call a "block-heater," i.e. an electric heater immersed in the coolant and heated from the house service. This draws about 60 to 100 watts at 110 volts a.c.

However, I think that someone has confused 60 deg. F of frost with 60 deg. F below zero. The latter is 92 deg. F of frost. Quite a difference!

Incidentally, this business of cold weather starting is one reason why British-made cars until recently have not been as popular as the North American types which are designed to *always* start.

I don't think I am prejudiced as I am very satisfied with my Ford Prefect which I have driven 52,000 miles over the past six years with no trouble to speak of. But I *do* have to use the block-heater and keep the ignition system in good shape to start at 25 deg. F. below zero as the car stands outdoors all year round no matter what the weather does.

My wife and I both enjoy the magazine very much. Keep up the good work.

Lachine, P.Q. C. B. MEYERS.

## CABLE HAULED

SIR,—I was interested to read Mr J. H. E. Rodgers' letter [Postbag, April 3] as I had just visited these engines on the 18 in. gauge track at Woodville. The present position is that owing to insurance difficulties locomotive working has been, or will be, replaced by cable haulage.

There are two engines *Jack*, Hunslet No 684, of 1898, and *Gwen*, Hunslet No 1404, of 1920. *Jack* lies in the shed and is unusable.

Nottingham. B. HAWKESWORTH.

## CHUCK TROUBLES

SIR,—I wonder if any other reader has experienced the trouble I have had with a new chuck.

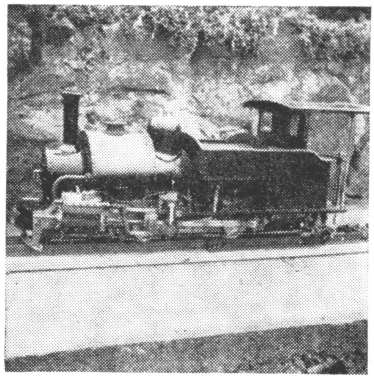
I recently bought a brand new 4 in. dia. geared scroll chuck of a very well known make, advertised in ME. It was a real precision job, beautifully finished.

I turned up a backplate for it, putting my best work into it. The result was it ran true to a thou. But when I came to use it great difficulty was found in turning the key, in fact it made my wrist ache.

If I had kept on with it my hand would have been unfit for me to do the job I wanted to. So the chuck, backplate, jaws, etc., were taken apart and I set to work with scrapers and carborundum slips to ease the tight parts, great care being taken to try each part as it was done. At first the jaws could not be moved in their proper guides and quite a considerable amount of stoning was required before a nice sliding fit was obtained. All the other parts received the same treatment.

The chuck was re-assembled and it was a pleasure to use and has been so for many months on very accurate work.

Hackney, E9. J. J. PIKE.



*An unusual model, by Mr B. King, of a locomotive of the 2 ft gauge Darjeeling railway in Northern India*

## MODEL SADDLE TANK

SIR,—My photograph shows the model locomotive of the 2 ft gauge Darjeeling Railway. The model, I started it in 1952, is built to the scale of 1¼ in. to the ft. I tried to keep to scale as much as possible but the cylinders and the steam chest had to be slightly longer to enable me to get a wider piston and a D-slide valve against the prototype's balanced valve.

The motion rods are overscale for a working model but everything else is to scale.

The water saddle tank in front of the dome feeds to a tank between the front and rear axle. From there it is picked up by an eccentric drive pump driven from the front axle and fed to the l.h. clack valve, a bypass valve operated from the cab, then the pump return direct to the tank.

The r.h. clack is fed by a hand operated pump situated in the r.h. coal shute, as an emergency.

The drawings were supplied to me by the North British Locomotive Co. of Glasgow. In my opinion this model will make a good garden railway locomotive where space is limited. It should pull a useful load.

I lived and worked in India for over 40 years and during that time I have crossed up to Darjeeling many times on short leave travelling on the small railway. I have also had a ride on the footplate and you have to hang on to the cab sides all the time as when the engine strikes a curve, and it is all curves, you get jerked from one side to the other. The driver works entirely on the throttle on the up journey, easing up on sharp curves, and full throttle when on a straight or slight curve.

Fifeshire. B. KING.

## STROUDLEY'S PUMPS

SIR,—K. N. Harris's letter [Postbag, April 24, page 530] on the subject of Stroudley's pumps exhibits such a display of complete ignorance on the matter about which he purports to write as to amaze the reader.

Stroudley stated (Proc. Inst. Mech. E., 1885) that as he turned part of his exhaust into the feed water the injector was not reliable for his purpose. No chink in his armour there.

With regard to the pressure of 900 lb. in the feed pipe, Prof. Goodman (*Goodman's Applied Hydraulics*) states that of this 700 arose from the inertia of the moving column of water in the feed pipe. Such an inertia occurs if motion is imparted to a column of water, if by pump (when the force is intermittent) or an injector, when the force is constant.

Twyford Mill, G. WOODCOCK.
Herts.

## RAIL ADHESION

SIR,—Mr Kingham is wrong in his theory about adhesion [Postbag, April 17] on new rails. New rails are definitely rougher than those that have a fair amount of use, the noise alone proves that, and an examination of rails that have had some use will show that they have acquired a smooth, almost polished, surface which is also harder than the surface when new.

A point which Mr Kingham and LBSC missed and which I think is of some importance is the depression of the rail at the points of contact of the wheels. The result of this depression, minute as it is, is that a locomotive in motion is climbing a perpetual incline.

The limited area of contact on rails that have not bedded in and the softer surface of the rail mean that the depression will be greater so more power will be needed to climb out of it, therefore there will be more likelihood of slipping.

Birmingham, 26. J. H. BELLEMY.

## GALLEONS "REACH"

SIR,—As a native of Highgate I have been following the salvage theories for the sunken galleons in Highgate pond with considerable interest.

May I suggest that the club acquire a mine detector of ex-Army type, waterproof the probe, lay off the pond in squares by aid of whitened posts in pairs on shore (for sighting the positions) and systematically search the area ? Even a wooden yacht will surely have enough metal in its lead keel to cause the mine detector to react.

Once the wreck is found the frogman can go overside and have a shorter and probably more profitable hunt than by blind groping. A safety line to the frogman should be of wire if the mud is gluey, and a phone to the surface might be rigged too.

Edinburgh. W. LOCH KIDSTON.

## 3.5 c.c. ENGINES

SIR,—In reply to E. H. Higgin's letter on 3.5 c.c. engines, I cannot see why a 3.5 c.c. engine of the plain bearing type is deplored as "not suitable for racing."

There are at least three plain bearing engines that come to mind that are first-class engines and that can at least reach some of the American 19s (3.5 c.c.) in speed. These are the AM 35, the ED Hunter and the DC Manxman. These three motors deliver between 10,000 and 14,000 r.p.m. in plain form.

With motors of 3.5 c.c. calibre on the British market today, I don't think you have much to complain about Mr E. H. Higgins.

As to "abhorring the battery and wire required by the glow motors (not to mention the price of the nitro-methane so necessary for good performance)," this is beyond me.

The one great advantage of the glowplug motor is that it does not require a great lot of fiddling as with a diesel, there being only the needle valve to open and close.

Another is that immediately the engine has started and is running smoothly, all battery leads may be disconnected, this being due to the fact that once it has fired a few times the heat generated, in conjunction with the fuel, is sufficient to keep the plug glowing and therefore the engine running. Moreover, you cannot lose compression either due to vibration or different fuels.

As for the price of nitro-methane, I agree that this is an expensive article but does one really have to buy it for racing purposes ? Nitro-benzine is not expensive surely if one uses it as an, say 20 to 25 per cent additive.

Leatherhead. M. G. DIAS.

## PRESERVATION OF CPR No. 29

SIR,—I entirely support the suggestion of Mr A. H. Castle [Postbag, 13 February 1958] for the preservation in Britain of CPR No 29.

It would almost be possible to connect the engine with those nostalgic films of life in the USA at the end of the 19th century and it would, therefore, be of wider appeal from that point of view.

I would very much like to associate myself with any action being taken. The scrap value of a locomotive I think could quite easily be raised as a preliminary.

Loures, ANTHONY WOODHOUSE.
Portugal.

# CLUB NEWS

## EDITED BY THE CLUBMAN

**DURING this sixtieth year of Model Engineer and the organised modelling movement, more than one club will watch with interest the future progress of Exeter and District Model Engineers' Society. Although Exeter MES—unlike some societies—has been pleasantly active of late, its members are keen on still better things. They want to do more and more, and to this end they have radically changed their executive committee.**

New and younger blood has been brought in, to such an extent that only the chancellor now remains from the former cabinet. At the annual meeting the chairman offered his resignation and was succeeded by S. H. Tombs. After a long discussion the members agreed on a new system which elects the secretary for 12 months only, with an assistant secretary who takes over for the following year. They hope in this way to overcome the natural reluctance of members to volunteer for a job from which there is usually no escape until old age brings release.

H. Godfree Angel of Belmoor, Longdown, Exeter, who had held the post for two months, showed his willingness to serve for the year. He deserves the support of all members.

In particular, the society wants to complete its O gauge layout. Thought is also being given to the possibilities of a multi-gauge track at one of the pleasure grounds in the city—a railway that would be more useful and satisfying than the 300 ft straight track in use at present.

The marine members would like a pool of their own, but it will not be easy to provide without outside help. Perhaps other clubs may care to offer suggestions here, as they did when I asked for ideas on salvaging small boats.

Usually there is no better way of getting outside help—from a local council, for instance—than by building the kind of public-park railway which the Exeter men are considering. Once the track is operating, the community becomes gratefully aware of its model engineers and eager to help them where it can.

Already this month the Exeter society has listened to talks on marine engines and automatic train control and has paid its fifth visit since March to a place of interest. Members were shown around Exeter Gasworks on May 22 and around the Western Counties Brickworks yesterday.

### BANG-ON BINGLEY !

There is no doubt about the 21st birthday celebrations of **Birmingham SME!** When the Bingley Hall exhibition closes on the last day of this month, the Birmingham society will have added another important event to the history of the model engineering movement in the Midlands capital: a history which goes back much further than 21 years, to the old society which came into existence half a century ago.

The exhibition is followed by a members' social day on June 1. Two Saturdays later the members set off on their summer outing—to Windsor. On June 29 they are entertaining some VIPs at Campbell Green—children of the Post Office. Surely one of the happiest aspects of modelling is the pleasure that models can give to the very young.

### JUNE JAUNT

June in the Pennines. Members of **The Railway Correspondence and Travel Society** are looking forward to 204 miles of pleasure on June 8 when their special train sets off on the Roses Rail Tour of the area between Manchester and Doncaster. Leaving Manchester at 9.4 a.m. the train (a fast diesel) will take in closed lines, and spurs and connecting junctions which are normally inaccessible, in the territory of the old Lancashire and Yorkshire, Midland, North Eastern, and the Great Northern and Great Central Railways. Doncaster locomotive works and motive power depot are to be visited.

### IS THIS THE OLDEST ?

Among the traction engines illustrated in ME of August 8 last year (page 209) was the 1932 Burrell *King George V.* The owner, L. C. W. Parris, has now organised a rally in which at least 20 steam engines will take part, including a Burrell of 1892. You will find them at Vicarage Lane, North Weald, three miles out of Epping, on May 31. Mr Parris lives—can this be coincidence ?—at Paris Hall Place, Hastingwood, Harlow, Essex.

The rally is in aid of the Local Churches Building Restoration Fund. I am sure that many will go to see, in particular, the 1892 Burrell. Is there an older traction engine still in use ? And what others over 60 are known to readers of this page ?

### FROM SOUTH AFRICA

"Congratulations on a wonderful issue," said H. Marshall Smith when he called to see us with a copy of the ME Diamond Jubilee number under his arm.

Still brown from the sun of South Africa, Mr Marshall Smith was exploring London after a tour of Europe. In Lucerne he visited the Dampf-Modell-Bahn, the famous little railway run by the Brast Brothers; in Zurich he saw the Modell-Eisenbahn-Grossanlage, a magnificent scenic layout in OO and O gauge; and in Holland, at The Hague, he was delighted with the Madurodam, a miniature township (not unlike Beaconscott) which raises money for sick children.

I do not know what he may have discovered on the way to Italy when he left London again for Rome and the flight back to Bloemfontein !

### "ONE OF THE REASONS"

In England Mr Marshall Smith was faced with the visitor's usual problem of what to see in the limited time. "The Science Museum," he said is one of the reasons why I came to England. I must also try to see the National Maritime at Greenwich." At my suggestion he attended the big rally near Baldock where a crowd of 15,000 bore witness to the respect which the traction engine commands in the England of automation and atomic power.

### ME DIARY

**May 29** The Model Engineers Society (Northern Ireland) exhibition, opening by N.I. Director of Education (May 29-31, 10 a.m.-10 p.m.).

**May 30** Glasgow SME, track day.

Golden Gate Live Steamers weekend meet (May 30-June 1).

**May 31** Edinburgh SME, bring and buy sale, Club Rooms, 3 p.m.

Traction engine rally, Vicarage Lane, North Weald, near Epping.

Wigan and District MES, visit by Edgar T. Westbury.

SMEE track meeting. Will members bring their locos. Visitors invited, 28 Wanless Road, London.

West Midlands Federation Rally, Wombourne (May 31, 2 p.m.; June 1, 11 a.m.).

Sheffield and District SMEE exhibition ends.

Birmingham exhibition ends.

**June 1** Birmingahm SME, social day at Campbell Green.

Acton MES visit to Hythe (study of railway and stations).

MPBA Forest Gate regatta.

Malden SME track day.

**June 26** The National Threshers Reunion, Montpelier, Ohio. (Alt. US 20, South; Ohio Turnpike), June 26-28.

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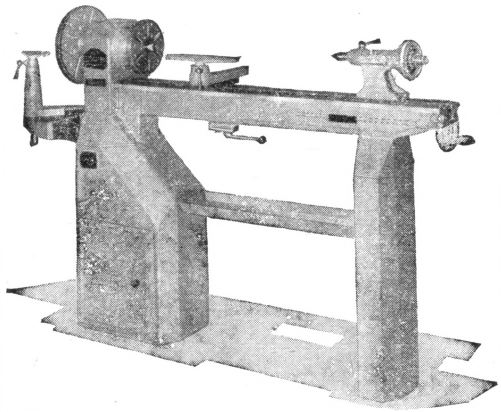

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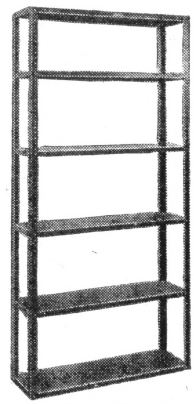

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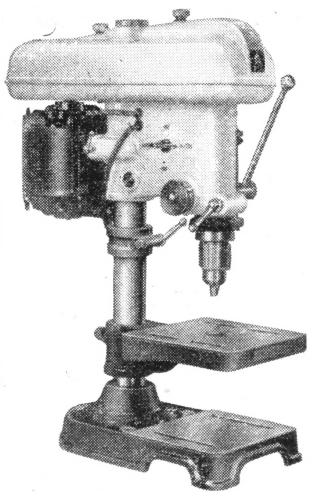

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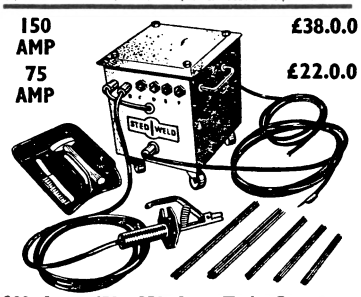


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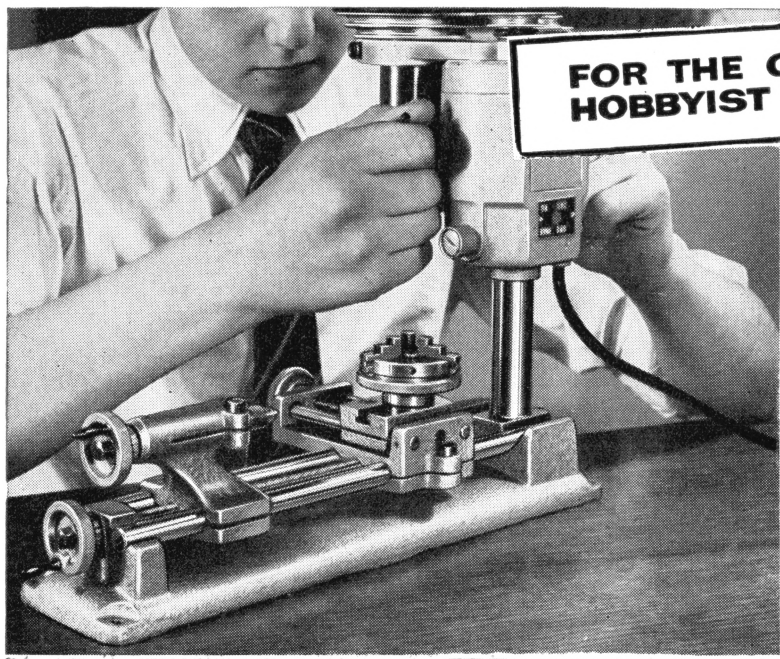

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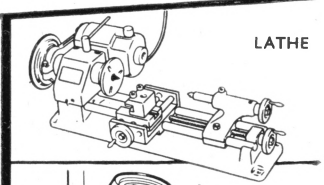

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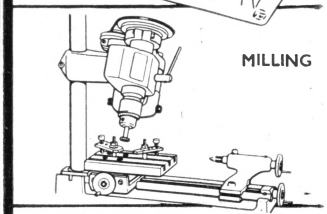

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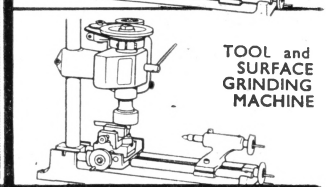

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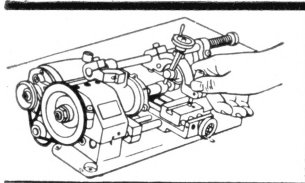

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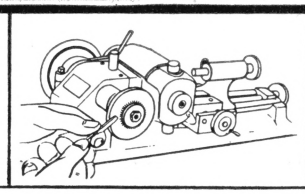

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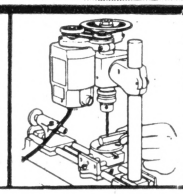

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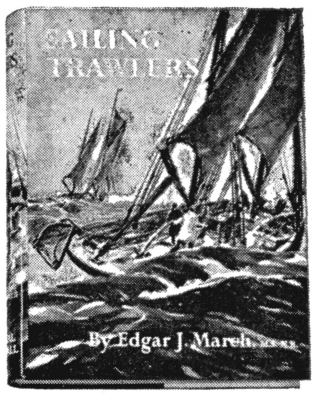


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